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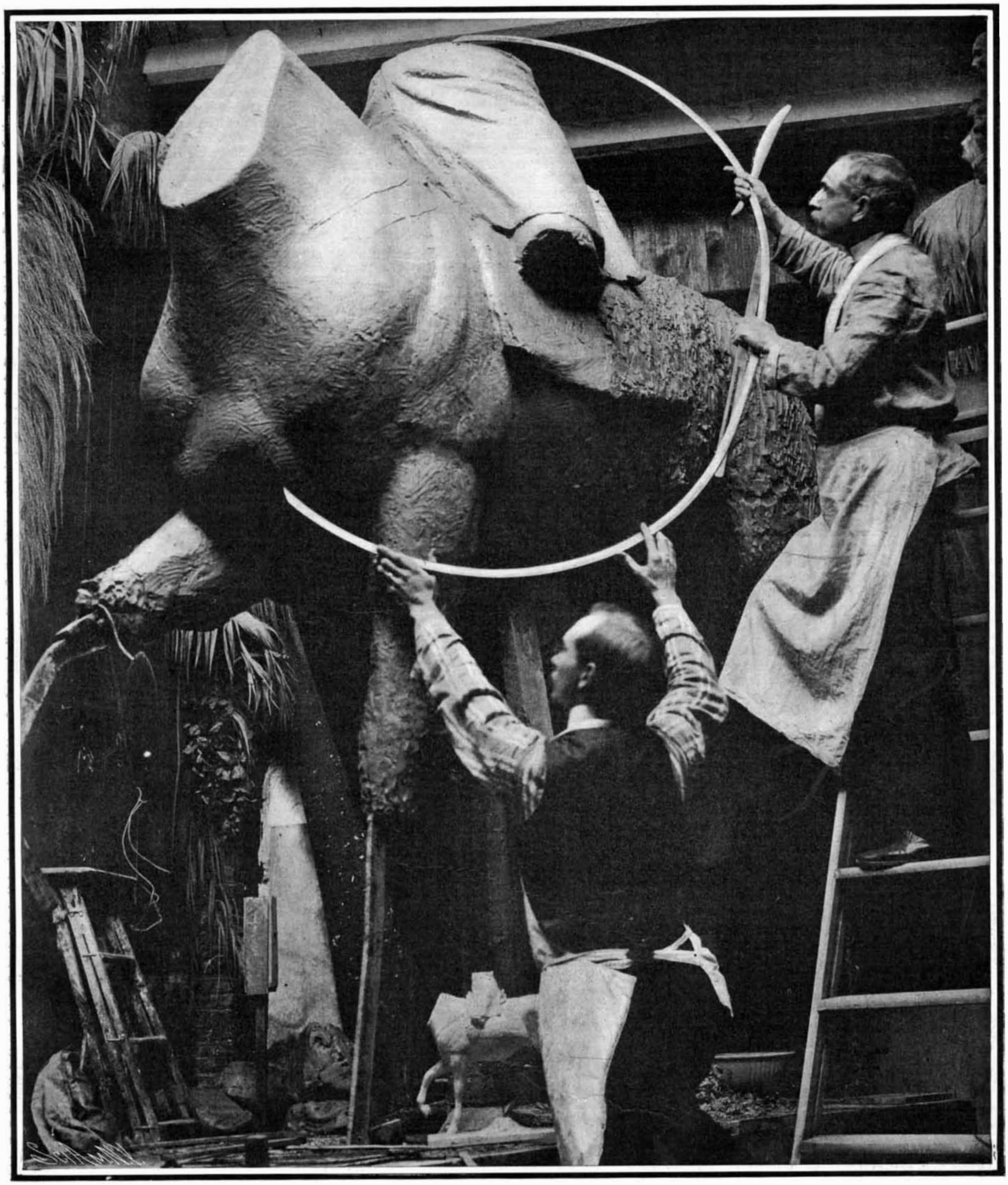
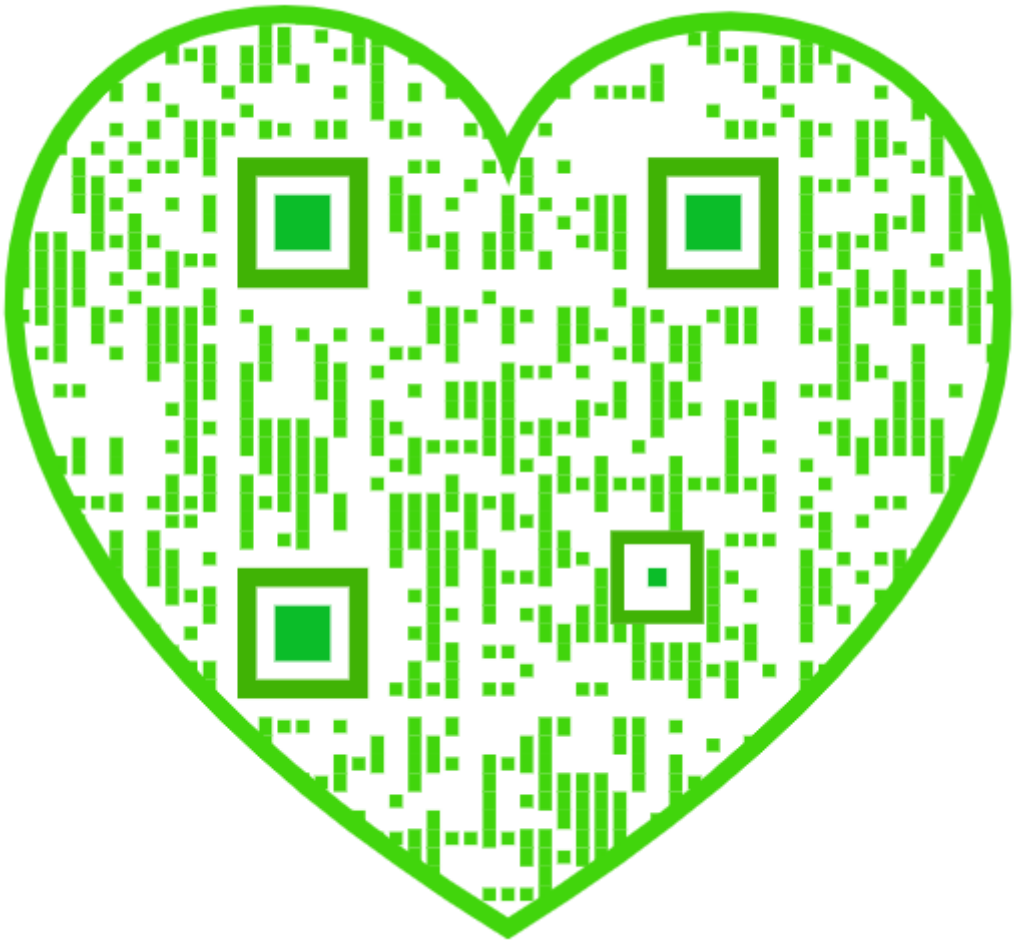


Making the Full-Size Clay Original, Working from a Small Wax or Clay Model.

THE "CIRE-PERDUE" PROCESS OF BRONZE CASTING.—[See page 264.]



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ESTABLISHED 1845

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NEW YORK, SATURDAY, OCTOBER 15, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ELEVATOR FATALITIES AND THEIR PREVENTION.

Recently, in these columns, we were deploring the number of fatalities that occur in transportation on our railroads; but now it seems that the risk of travel on railroads is insignificant compared with that to which those who use the modern elevator are exposed —at least in New York city. For according to a statement of Coroner Jackson, no less than thirty persons have lost their lives in elevator accidents in this city since the opening of the present year; and, of course, a still larger number of people have received injuries more or less serious. Although we had noticed the frequency with which accounts of elevator disasters appeared in the daily press, we were certainly not prepared for this astounding statement from an official whose duty it is to know the facts. Think of it; thirty deaths in nine months, or a rate of forty per year killed in one city alone, in a form of accident that would be altogether preventable were human life not held so cheap, and were ordinary care exercised in the selection and operation of the plant.

There is absolutely no excuse for ninety-five per cent of the accidents that occur. The problem of providing an elevator that shall be perfectly able to perform its work, year in, year out, without any risk to the passenger, has been most carefully thought out and solved by the best mechanical and engineering talent of the day, with the result that there are on the market to-day elevator systems which, in the hands of competent operators and subjected to constant and competent inspection, provide as safe a form of transportation as any that exists. Unfortunately for the safety of life and limb of the public, accident-proof elevator systems cost money, and the combined parsimony and disregard for human safety of many of the owners of office buildings and warehouses leads to the selection of inferior and cheaper systems, of which there are sadly too many in this city at the present day. Moreover, there is apparently very little care exercised in the selection of operators. The elevators in important and crowded office buildings are often in the hands of mere boys, the test of whose fitness for the job seems to be the small amount of pay for which they will undertake it.

In view of the present condition of affairs, which can only be described as positively alarming, we are glad to learn that the Superintendent of the Department of Public Buildings has drawn up an amendment to the Building Code which seems to cover the case adequately, and will make it possible for the Building Department to enforce any needed alterations in faulty elevators, whether they are used for passengers or freight. The principal items of the amendment are, that the Superintendent of Buildings shall cause an inspection of elevators, whether for passengers or employes, to be made at least every three months, and that he shall prescribe suitable qualifications for persons who are placed in charge of the running of passenger or freight elevators; any repairs found necessary by the Department to be made without delay by the owner or lessee. In case defects are found to exist which endanger life or limb, the use of such elevator, upon notice being given by the Superintendent of Buildings, shall at once cease, and it shall not again be used until the Superintendent has granted a certificate certifying that the elevator has been made safe. Moreover, no person will be permitted to take charge of an elevator, whether for passengers or for freight, unless he shall first register at the office of the Superintendent of Buildings, giving his name and residence, and the location of the building in which he is to be employed, and shall first receive from the Superintendent of Buildings a certificate as to his competency. Now this is a really admirable measure. It covers the case adequately, and if its requirements are honestly carried out without fear or favor, there is no reason why the public should not be as safe in an elevator as they are upon the sidewalk or in their own homes.

BIG GUNS FOR FUTURE WARSHIPS.

Already the naval expert has begun to tabulate the lessons to be gathered from the naval war in the Far East. In some respects they vary widely; but there is one point on which they are all agreed, and that is as to the great value of the larger-caliber guns, say from the 8-inch to the 12-inch, as compared with the more rapid but less powerful guns of 6-inch caliber and less. Before the war we heard a great deal about the wonderful "hail of rapid-fire shell" with which the ship which carried a numerous battery of 5-inch and 6-inch guns was to "smother" her adversary, and "wreck his unprotected sides and upper works." The Japanese tactics, forced upon him by the necessity of defeating the enemy with as little loss as possible to himself, have changed all that. Japan possessed only a limited navy, every ship of which was thrown at once into the field of operations. She had absolutely no reserve to draw upon, and any gap that was made in her fighting line she could not hope to fill up. Hence, in the battles of the war, whether against ships in the open or against land fortifications, she has elected to fight, or rather she had no choice but to fight at long range, trusting to her superior seamanship and gunnery to enable her to place a larger percentage of effective hits upon the enemy than he could hope to do upon her own ships. The events of the war have shown that these tactics were correct; for the enormous losses that her gunners have inflicted upon the enemy have been brought about without the loss of a single ship, or even its serious disablement, at least as far as we know, by Russian gun fire.

To carry on a successful artillery duel at long range, however, is only possible with the high-powered, large-calibered gun. At the ranges of from 5,000 to 8,000 yards, at which the Japanese elected to fight, the 6-inch, 5-inch, and smaller-caliber guns were useless, the velocity of the smaller projectiles falling off so rapidly that they were, at such ranges, altogether ineffectual against the armored portions of a ship. Under such conditions, the engagements resolved themselves into a trial of skill between the marksmen of the 12-inch and 8-inch guns. And how excellent this was on the Japanese side may be judged from the fact that the official report sent in from the flagship "Czarevitch" spoke of her as having received three 12-inch projectiles in the neighborhood of the conning tower within a space of five minutes. Evidently the gun is supreme, and the big gun at that.

The effect of the war is showing itself in the designs for new battleships and cruisers that have lately been divulged. Japan herself has ordered from an English shipyard two battleships that will carry four 12-inch and four 10-inch guns, and a dozen 6-inch. The 10-inch gun forms the main battery of many modern battleships, notably those of the "Pobieda" class, now at Port Arthur, so that practically the new ships will have double the number of armor-piercing guns of the first class that are now carried by modern battleships. The British government are also following the same policy. Their new battleships of the "Lord Nelson" class will carry four 12-inch guns of 45 calibers, but no 6-inch or 7½-inch, their place being taken by ten 9.2-inch guns of 50 calibers. Thus the whole of the main battery consists of armor-piercing guns of long range and great penetrative power, while the intermediate or secondary battery has been abolished, and the vessel carries in its place a numerous battery of small 3-inch and other rapid-firers for protection against torpedo-boat attack. The same policy has been followed in the first-class cruisers of the "Minotaur" class, which will not mount any 6-inch guns, but will be armed with four 50-caliber 9.2-inch guns and ten 50-caliber 7.5-inch rapid-firers.

The 9.2-inch piece, which was recently illustrated in this journal, fires a 380-pound shell with a muzzle velocity of 3,100 feet per second, a muzzle energy of 25,485 foot-tons, and is capable of penetrating 12 inches of Krupp steel at a range of 3,000 yards. The 7.5-inch gun, which forms the secondary battery of the cruisers, has a muzzle velocity of 3,000 feet per second, and fires a 200-pound shell, with a muzzle energy of 12,540 foot-tons, and is capable of penetrating 8 inches of Krupp steel at a range of 3,000 yards. It is an interesting conjecture as to just where this progression toward the exclusive use of the larger-caliber guns will go; but it begins to look altogether possible, that before long we shall see the dream of Admiral Cuniberti of the Italian navy realized, when he drew up his plans for a 17,000-ton battleship, carrying an armament of twelve 12-inch guns and a dozen 12-pounders.

EXPERIMENTS ON THE MOSQUITO.

BY T. H. EVANS, M.D.

If the following experiments are interesting and curious they may also be valuable, for any matter concerning the habits of *Stegomyia fasciata* is of use in view of their relation to the transmission of infectious disease, as malaria, yellow fever, etc.

Experiment I. Securing the mosquito so that it cannot escape, and allowing the wings and proboscis free movement, a drop of liquid on the end of a blunt probe is approached to the proboscis. When the distance of the proboscis from the drop of liquid is reduced to about two millimeters, the proboscis darts into it. Various liquids seem to bring about different distances of attraction.

Experiment II. If a drop of lysol, a phenol derivative, has been used, the proboscis darts into it at the distance of two millimeters. In the space of two or three seconds the wings relax and droop, but do not flutter unless the experiment has been performed while they were in that state of excitement.

Experiment III. A solution of ammonia produces the same results, but in shorter time and over a wider interval of attraction.

Experiment IV. Repeated tests on the same animal, using poisonous solutions, give identical results while life lasts. From the fact that the proboscis continues to fly toward even poisonous solutions, and after their effects are apparent in weakening of vitality, I take it that—

(a) The movement of the proboscis is not voluntary, or not under the control of a reasoning intelligence.

(b) There is some inward suction, more or less constant, in the passageway of the proboscis.

(c) Lysol and other solutions may produce poisonous effects when introduced by means of this passageway to the mosquito's economy.

ARSENIC NEEDED FOR THE BODY AND FOUND IN DIFFERENT FOODS.

Not long ago M. Armand Gautier brought out the fact that arsenic is contained in minute quantities in nearly all the organs of the body. In some of the organs the proportion is relatively large, and leads us to suppose that this element is necessary for the proper working of these organs, and indeed plays an important rôle in the entire system. In a paper which he recently presented to the Académie des Sciences he brings out some further researches upon this point. These relate especially to the different kinds of food from which the system takes its supply of arsenic. This element is found in a large proportion in the exterior parts of the body, and a certain amount is constantly being lost through the falling or cutting of the hair and nails, and also by the natural evacuations. It became therefore of interest to find out from what sources the system receives the amount of arsenic which is needed to keep up the normal amount, and what is the proportion given by the various kinds of food, both animal and vegetable. Accordingly he made a series of analyses of different foods and showed the quantity of arsenic in each. The method he uses is to break down the organic tissue by a mixture of one part sulphuric and ten parts nitric acid. This is carried out at a low temperature. After re-treating with nitric acid the whole is finally carbonized. The arsenic is set free by a Marsh apparatus, at least in most cases. In the case of salt and water it is found by direct precipitation. Great care was of course taken to use perfectly pure reagents. The following extracts are taken from the table which M. Gautier has drawn up as showing the percentage of arsenic in different foods, water, and salt absorbed by the body. The figure gives the weight of arsenic in 0.001 milligramme per 100 grammes (0.22 pound) of solids in the fresh state or in 1 liter of liquid: Beef (lean), 0.8; milk, 1.0; eggs, yolk, 0.5; white, 0.0; mackerel, 3.9; lobster (muscular part), 2.2; eggs, 35.7; shell, 104; water extract, 10.7; shrimp, 0.16; shell of same, 7.6; wheat, 0.7; potato, 1.12; wine, 0.89; beer, 0.01; salt, refined, 0.7; gray salt, 45; rock salt, 14; Seine water, 0.5; sea water from surface, 1.1; from 30 feet depth, 2.5. The unusually large proportion contained in lobster shell and unrefined salt will be noted. Eggs have also a very high value.

From these results we may draw certain conclusions. The proportion of arsenic is extremely small in the muscular flesh of mammals as compared with that which the arsenic-bearing organs contain. Among the different foods, some of the fish and crustaceans, and especially their more highly phosphated products, are found to contain the largest proportion of arsenic. Rock salt is also one of the highest in the list. Wheat bread contains very little, and the proportion is not greater for Graham bread, showing that this element is not furnished by the bran. Green leaves, cabbage, and green beans do not show a trace of it, even in a large quantity of matter. This seems to show that arsenic is not essential for cell-life, at least in the proportion of 0.001 milligramme per kilogramme. On the contrary, the system derives a considerable quantity from water, wine, and common salt. M. Gautier utilizes his results to make an interesting calculation as to just how much arsenic an inhabitant of Paris absorbs per day on the average, taking as a base the statistics for the last decade. The result is as follows: The first figure gives the number of grammes (15.43 grains) of food per day, and the second the quantity of arsenic (in 0.001 milligramme): Bread and pastry, 420 grammes per day (arsenic, 2.9); meat, 180 (1.8); fish, 35 (4.3); eggs, 24 (0.05); vegetables, fresh, 250 (0.5); vegetables, dry, 40 (?); potatoes, 100 (1.12); milk, 213 (0.10); wine, 518 (2.9); beer, 30 (0.0); salt, 10 (2.3);

water, 1 liter (5.0). The total quantity of arsenic taken into the system per day thus figures very close to 0.021 milligramme, or about 0.0003 grain.

AUTOMOBILE STEEL SPECIALTIES.

BY GEORGE E. WALSH.

The manufacture of automobiles has reached such a stage of development that it proves a most important factor in the iron and steel trade. The millions of dollars invested in automobile plants indicate something of the growth of this special line of business. Already the tendency toward the standardization of the different parts of the automobile has progressed rapidly, and it may not be long before shops will be established for the mere assembling of the machines without any attempt to manufacture. Under existing conditions of patent rights and special manufacturing methods, it is possible to do this to-day without infringing upon the rights of others.

Automobile steel has called for special lines of manufacture and experiment that have proved of advantage to mills anxious to capture this trade. The amount of steel that goes into the ordinary automobile is variously estimated from ¼ to 1 ton, according to the size and capacity of the machine either for passenger or freight traffic. If the average is placed at 1,000 pounds, a manufacturing output of 5,000 machines a year would represent a total tonnage of 5,000,000 pounds of steel required for this particular line of industry. But this estimate is comparatively low, and within a year or two the plants will be turning out far more than this number. The orders at the last automobile exhibition in New York for new machines amounted to considerably more than a million dollars. With the average cost of a machine placed at a thousand dollars, this would represent over a thousand machines sold or ordered in one brief fortnight.

The iron and steel used in automobiles represents all degrees of hardness and strength. For the most part only the finest steel can enter into the manufacture of the driving part of the vehicle, and in the case of the high-power automobiles unusual strength of parts is required. In the specialization of parts there has grown up a line of steel manufacturing that is of peculiar interest.

The gears, chains, springs, and machine parts require steel so strong that it will stand the greatest resisting power. Extensive experiments have been carried on in some of the automobile plants with steel to test its qualities for the driving parts of the high-power automobiles. In one such series of tests over fifty tons of steel billets were destroyed to secure the most efficient results. As in the manufacture of high-power tool steel, there has been a gradual series of experiments that have virtually led up to the production of an article satisfactory to the trade. Most of the large automobile manufacturers have their own ideas of the kind and quality of steel they need, and the chemical tests and analyses show that they differ in the composition to only a slight degree. As the strength of the automobile must in the last analysis depend upon the quality of the steel used for the most important parts, it is quite evident that the manufacturers are justified in studying this problem exhaustively. In the former cheap grades of machines, the breakdowns were due to some inferior steel parts that would give way in critical moments under the stress of special strains imposed upon them.

The modern American automobile is nearly, if not quite, as strong, powerful, and durable as the best French machines, and it is due as much to the special manufacture of important steel parts as to the gradual perfection of boiler, engines, and electrical equipments. A good many of the manufacturers require air-hardened steel for parts that must be subjected to considerable strain and friction in the operation of the machines. The heating of the steel to a high temperature, and cooling suddenly in a blast of air, can give to the steel the desirable hardening qualities; but unless the compressed air-blast is sufficient to reduce the temperature of the steel uniformly and quickly there is always the danger of cracking and weakening of the parts.

As in the manufacture of steel for cutting tools and other high-grade purposes, there is a good deal of difference of opinion in the automobile trade as to the methods of obtaining the best steel for the machines. The application of water for reducing the temperature of the steel is employed differently in the various plants. There seems to be no absolute consensus of opinion in the trade regarding the exact treatment of the steel. A manufacturer who has had success with steel treated in one way cannot easily be induced to adopt any other method. He is slow to adopt new products of the steel trade.

Nevertheless, steel mills are not indifferent to the demands of the new trade. They have taken the matter up for serious consideration, and some of them are constantly carrying on tests for the benefit of the automobile trade, exhibiting to their customers the data thus obtained for their benefit. Thus in manufacturing the chains, sprocket wheels, and gearing of the high-power automobiles, specially refined and annealed steel has been made, which will practically withstand any amount of strain that can be imposed upon it by even a forty-horse-power motor. This steel is not only chemically perfect, but it can be made in the most uniform manner. This latter point is one of great importance to the automobile manufacturers. A standard machine must be guaranteed in all particulars, and each successive machine must be up to the same standard. Any lack of uniformity in the steel parts would manifestly handicap the manufacturers in guaranteeing the durability of the machines.

The wear and tear on automobiles must necessarily be greater than on cars which run on smooth rails or tracks, and consequently the item of repairs has always been large. The life of an automobile has been short owing to the lack of uniformity of steel parts, but manufacturers to-day are willing to guarantee the life of the average machine to be nearly twenty per cent longer than that of the machine built five years ago. This is largely due to the superiority of the parts used, and their more perfect operation when in use. The quality of the steel employed has steadily enhanced the usefulness of the automobile, and also improved its power and durability.

The cost of manufacture is always an item of prime importance, and the temptation to use inferior steel parts to lessen the cost of manufacture is strong, but it must be said in all fairness that few of the responsible manufacturers of machines in this country are willing to sacrifice the reputation of their machines through any such short-sighted policy of false economy. The tendency is to use the best steel more and more, and to have every piece severely tested chemically and mechanically. The chemical test does not count for much in many plants, while special stress is placed upon the mechanical test. In other plants special emphasis is placed upon the chemical test, and all steel is immediately rejected that will not come up to the required chemical test. The later mechanical test is then applied to make sure of the accuracy of the first. The cost of maintaining a special laboratory for chemical and mechanical tests of all steel parts is quite considerable, and some of the plants are anxious to abolish it as a part of their equipment. But in their opinion this can only be done when manufacturers of steel will furnish them with a guaranteed uniform steel of certain qualities. Several of the steel plants are doing this to-day, furnishing elaborate data of chemical and mechanical tests with each piece of steel manufactured. These tests are open to the inspection of all, and the automobile manufacturers can any day assure themselves by personal inspection of the accuracy of the tests.

MUNICIPAL BAKERY EXPERIMENTS IN SICILY.

The British consul at Sicily, in his latest reports, supplies some interesting details concerning the experiments of the Palermo municipality with baking and supplying breadstuffs for the inhabitants. During the past few years, the flour trade of Palermo had been effectively cornered by one private establishment, and became practically a monopoly. It is estimated that the population of the city, which aggregates about 325,000 persons, consumes 260,000 pounds of bread and 110,000 pounds of macaroni daily. As the constituents of these staple foods were in the hands of one firm, the price of common bread was inflated to five cents per pound, thereby causing distress among the poorer classes of the city. Thereupon, in order to alleviate this suffering, the civic authorities decided to establish municipal bakeries.

In March, 1903, the system was inaugurated by the baking of some 20,000 pounds of bread daily. The success of the experiment necessitated the utilization of the military emergency ovens, capable of turning out 11,000 pounds of bread per diem. In May the municipality acquired a private flour mill on a two years' contract. This mill was of Italian construction. It employs 55 hands permanently, and 30 day laborers, and can turn out in 24 hours, working day and night, about 50 tons of flour. Attached to the mill is an old-fashioned bakery capable of producing 20,000 pounds of bread daily, and a modern bakery, which kneads the flour mechanically and produces 8,800 pounds of bread per diem. During the initial stages of this municipal venture, municipal officials were detailed to the work in almost all its branches, and the municipal police retailed the bread in huts placed in the principal streets. The sum of $30,000 was set aside as capital for working the mill and bakery. The municipality actually produces some 44,000 pounds of bread daily—about a sixth of the daily consumption of the city of Palermo. It serves the purpose of maintaining the standard rates which the municipality considered equitable, and allowing a fair profit to the trade. The net result has been a reduction of the prices of the different qualities of bread by about one cent per pound.

The municipality retails its flour and by-products to the public. There are twenty-four shanties where the bread is sold by municipal guards, who receive, in addition to their ordinary pay, a premium of two cents per five dollars of cash taken. When the shanties were first put up, a good deal of hostility was shown them. Private retail dealers are encouraged to take up the distribution of the bread. They pay all their expenses out of a profit of 15 cents per 200 pounds weight of bread, which is delivered to them free. At the present moment there are some thirty such retail dealers. The municipality is planning the erection of a flour mill capable of dealing with 300 tons of grain daily, and of a bakery which shall produce 26,500 pounds of bread, besides pastes, daily.

AUTOMOBILE NOTES.

In a crowded garage, there is often considerable difficulty in moving the vehicles around in getting them in and out of their places, and in order that this may be done with the least possible expense of floor space, a western manufacturer of accessories has made a roller device more like a roller skate than anything else, which is designed to be slipped under the wheels of the automobile, whereupon it may move around in its own length. A pair of these will answer all purposes and it is not necessary to have one of the devices under each wheel. The wheels on these are pivoted in the same manner as casters.

Among the recently introduced automobile accessories is a leather tire which comes from England and which is said to be much more serviceable and less expensive than the tires of rubber. The tire consists of an inner tube and shoe, with an additional shoe of leather. Over the running surface of the leather shoe is an auxiliary strip of leather fastened with a number of heavy rivets. The double ply of leather makes a very substantial tire, and the metal of the rivets is said to take a hold on the surface of the road, no matter what its character, that makes anything like an anti-skidding device quite unnecessary.

The Automobile Club of France announces that the next annual show will be held in the Grand Palais from the 9th to the 25th of December. In order to make this year's show especially brilliant the committee is organizing an annex show in the large Horticultural Building near by. Here will be found a series of veritable factories, which will give the public an idea of the successive phases of construction of an automobile car. Already numerous propositions have come in to the commission and no doubt many of the large firms will be represented. This will form an interesting feature of the show, and a most instructive one.

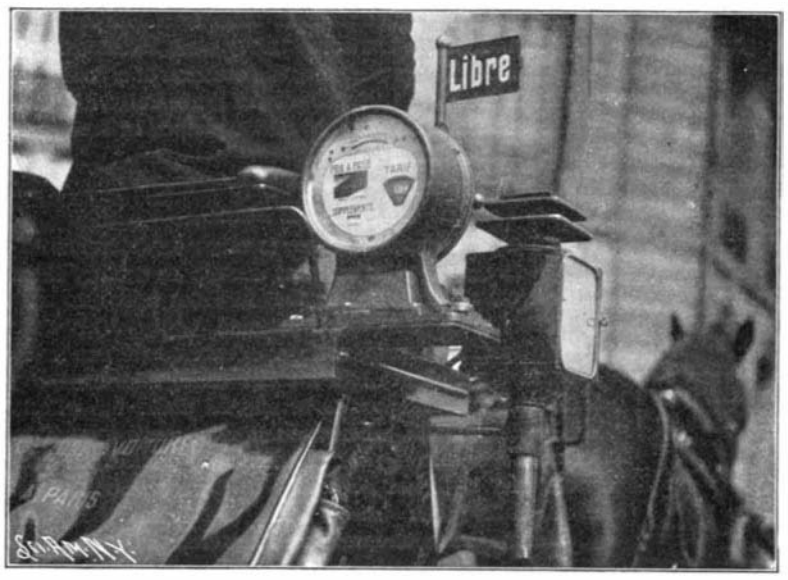
By the arrival in New York on October 7 of the 24-horse-power Columbia touring car, the Chicago-New York road record for the intervening distance of 1,127 miles was reduced to 58 hours and 45 minutes. The car was driven by H. H. Holcomb, Lawrence Duffy, and E. C. Bald, who alternated at the wheel. The best previous record, which was made a short time ago by Messrs. Ellis and Schmidt, of Chicago, in an Apperson car, was 72 hours, 36 minutes, so that the new record very materially reduces this. The last part of the journey was through the Catskill Mountains and was made through heavy showers; but not a mishap occurred then or throughout any of the trip. The test has shown well the endurance of the stock Columbia machine.

It would hardly seem likely that there would be any demand for a bucket capable of being carried in the pocket, but such a device has been recently placed on the market. The thing was primarily designed for the use of automobilists who require to take on a supply of water at regular intervals but it is also said to be a convenience to campers and tourists. The device is made of waterproofed material fastened to a jointed frame, and when it is desired to pack the thing in a small space, it can be folded up to a size about the same as a pocket hat. If it were necessary to carry the bucket in the pocket it could be done without trouble. Since putting the bucket on the market the manufacturers have made and are selling a small bathtub on precisely the same lines, which is said to be a great convenience in the nursery.

A new type of tire especially adapted for automobiles has been designed by a London inventor. Instead of a single inner air tube there are two, placed side by side on a steel rim. These are inclosed and protected by an outer head made of hard *papier maché* in sections of twelve or more. Each of these tread shields, as they are called, is attached to the rim of the wheel, by means of a bolt which has a free up and down movement, but has no lateral play. When all these shields are fixed in position, they constitute a kind of armor around the two air tubes. By this arrangement it is claimed punctures are rendered impossible, unless the *papier maché* is pierced, which, in view of its hard texture, is considered impossible. The heads, however, present a resilient surface to the road. Precautions against side slip are provided by means of links which are placed between each tread shield.

THE TAXOMETER.

The accompanying figure illustrates a new type of counter recently adopted for the public hacks of Paris. The apparatus is actuated by a very simple mechanism that causes it to register, through a measurement of the number of revolutions of one of the wheels, the distance traveled by the vehicle during the period of time indicated by a clock carried by the counter.



THE DISTANCE AND FARE INDICATOR IN USE ON PARISIAN HACKS.

A tappet secured to a collar mounted upon the hub of one of the wheels strikes, once per revolution, the cam of a pump fixed to the axle. Each of these impacts produces a variation in the pressure of a volume of air contained in the pump; and such variation is transmitted, through a rubber tube, to a small bulb of which every inflation causes a ratchet wheel to revolve by one tooth, through the intermedium of a metallic rod. A train of multiplying wheels, analogous to those of a clock, afterward causes the following readings to appear upon the dial: "Fare to be paid," "Distance traveled," "Extra fare," etc. Every 400 meters (about ¼ of a mile), for example, the fare to be paid increases by 10 centimes (2 cents). From the experience of the short time that has elapsed since the appearance of the first hacks with these counters, the following conclusions may be deduced: The new fare is very advantageous for short trips. The first hour costs more than formerly, say 2½ francs (50 cents) instead of 2 (40 cents); but this is largely compensated for by the privilege allowed the passenger of stopping as many times as he desires without being compelled to pay for the complete hour.

New Carbon Compound.

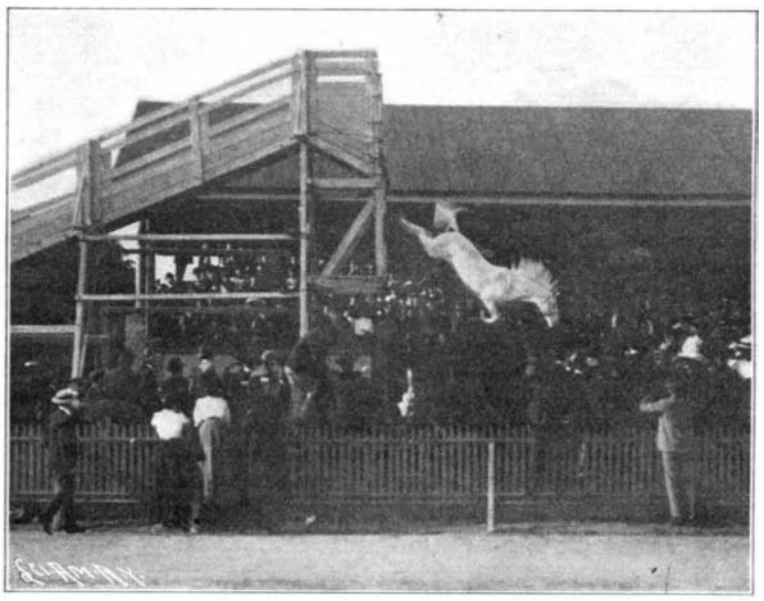
At a recent meeting of the Academy of Sciences of France, held at Paris, M. Henri Moissan presented a paper concerning the preparation and characteristics of a new carbon compound containing molybdenum. This compound is obtained by heating charcoal with melted molybdenum and aluminium in an electric furnace. The resultant metallic mass is treated with a concentrated solution of potash, and needles of well-defined crystals of the new carbon compound are obtained.

The substance is very hard, is hardly attacked by acids other than nitric, and is not decomposed by water or steam at a temperature below 600 deg. C. It resembles the carburet of tungsten, already known, which is not considered surprising, as the metals tungsten and molybdenum are much alike. It is thought that this new compound may play a rôle in molybdenum steels. The method of preparation shows that even at a rather high temperature (that of boiling aluminium) a molybdenum compound is obtained which contains twice as much carbon as the compounds formed at the highest heat obtainable in the electric furnace.

THE DIVING HORSE.

Our illustration of a horse in midair represents very forcibly the possibilities of animal training. An incline runway about 25 feet above the ground is arranged for the horses to walk or run up, from which they make a plunge and fall into a tank of water below about 12 by 20 feet in area and 12 feet deep. Usually the horses like to make the dive, and the moment they come in sight of the runway they fight to get to it first. The mare goes up first and without hesitation jumps off. The stallion, however, is more diplomatic, for he excites the onlookers by bows right and left, and then after an inspection of the surroundings he goes slowly forward and quite deliberately jumps, successfully rising in the water well pleased as the crowd cheers.

It appears to be as much sport to the horses as to the spectators.



THE TRAINED DIVING HORSE.

TRANSPORTABLE WIRELESS TELEGRAPH STATION FOR WAR PURPOSES.

BY OUR BERLIN CORRESPONDENT.

The company which was started some time ago as a consequence of an understanding brought about between the two leading German electrical companies, has since the beginning paid special attention to the use of wireless telegraphy both for naval and military purposes. According to the results so far obtained, communication by two bodies of troops within four days' marching distance of each other is possible with the Morse recording apparatus, while with an acoustic indicator the distance may even be doubled.

In the following, a short description is given of their latest form of portable stations for military purposes.

The stations are arranged for two wave lengths, namely, for a short wave of 350 meters and a long wave of 1,050 meters, the antenna remaining the same for both. With the short wave, the antenna will oscillate in three-quarters, and with the long wave in one-quarter of a wave. The antenna is outbalanced, in the first case, by a counterweight of 6 square meters of copper gauze extended at a height of about 1 meter from the ground, while the amount necessary in the second case is as high as twenty-four square meters. The antenna is supported either by balloons or by linen kites; the former have a volume of 10 cubic meters and a draft of about 3 kilogrammes, while the effective wind surface of the latter is 1.1 square meter, so as to be used even in the case of small wind pressures on account of the saving of gas.

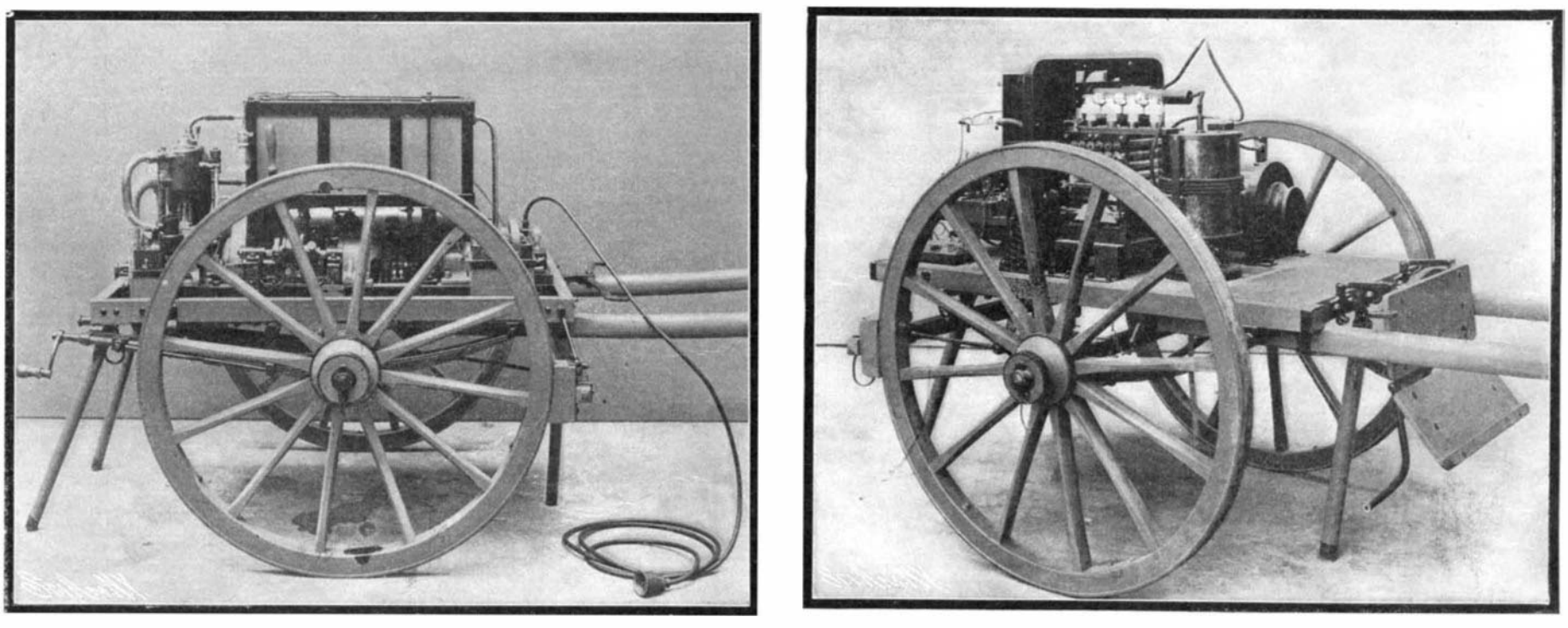
Each station comprises three two-wheel carts, namely, first the power cart; second, the apparatus cart; and third, the tool cart.

The power cart contains the source of current, consisting of a benzine motor of about 4 horse-power, direct-connected to an alternating current generator of an effective output of about 1 kilowatt, and the exciter. The cooling of the motor is effected by water, carried along in a reservoir located above the benzine dynamo. The circulation of the water is effected automatically by means of a small cog-wheel pump, the water being cooled by a tube system and by a ventilator. The benzine necessary for the operation of the motor is carried in a reservoir about 30 liters in capacity, located adjacent to the water receptacle, this capacity being sufficient for a continuous telegraphic service of about 30 hours.

The igniter of the motor is electrical and operated by accumulators, charged automatically from the exciter of the alternate current generator.

A full supply of accessories and reserve parts is located in the tool box fixed outside of the cart, the side walls of which contain, in addition, the two counterweights as well as bars supporting the latter.

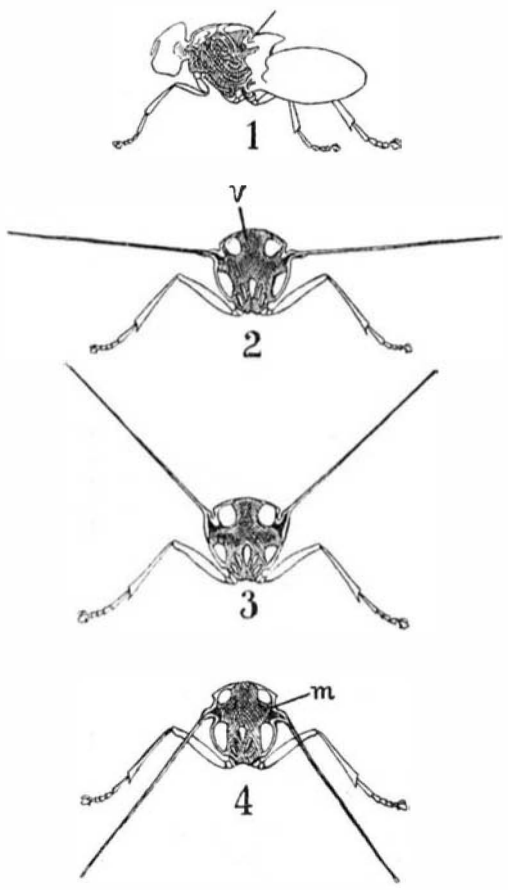
The apparatus cart, separated into two compartments by a frame, contains both the sending and receiving apparatus. In the front part, protected against contacts, are located the high-tension instruments, comprising the induction coil, a battery of Leyden jars with adjustable spark gaps and the high-tension transformer. By means of a door on the side wall easy access is afforded to permit the renewal of the Leyden jars and the regulation of the spark gap. In the rear is arranged the Morse key, and on a board placed on stout springs, two receiving apparatus and a Morse recorder, while on the board of the latter the smaller receiving transformer is located. On the frame separating the car has been arranged the large receiving transformer, the receiving plug as well as a counterweight switch with two levers. On one of the side walls is the acoustic indicator, comprising an electro-



TRANSPORTABLE WIRELESS TELEGRAPH STATION FOR WAR PURPOSES.

lytic detector and a telephone, while on the door a removable alarm bell has been placed. These instruments have been so installed as to permit the removal of the upper part without withdrawing any connection. The accumulator necessary for lighting purposes is placed in a protecting box at the left-hand outer side.

The tool car, finally, contains the gas reservoir and the necessary intrenching tools, as well as the balloon



INSECT WING MECHANISM.

1.—Longitudinal section through thorax of blue-bottle fly (*Calliphora*). Arrow shows position of wing. 2.—Cross section of same, through wings, showing the vertical muscles, *v*, and the lateral arms, *m*, attached to the wings. 3.—Extreme upward position of wings during flight and the lateral muscles in the lower position. 4.—Extreme downward position of the wings in flight and the lateral muscles in the upper position.

and a reserve benzine reservoir. The gas receptacles are built in the car and have each a capacity of about 5 cubic meters at a pressure of 120 atmospheres, two reservoirs being sufficient for filling the balloon with the aid of a filling hose.

The same outfit has been used in connection with the Gordon Bennett cup for signaling the progress of the race from one point of the race ground to the other.

INSECT WINGS.

BY S. FRANK AARON.

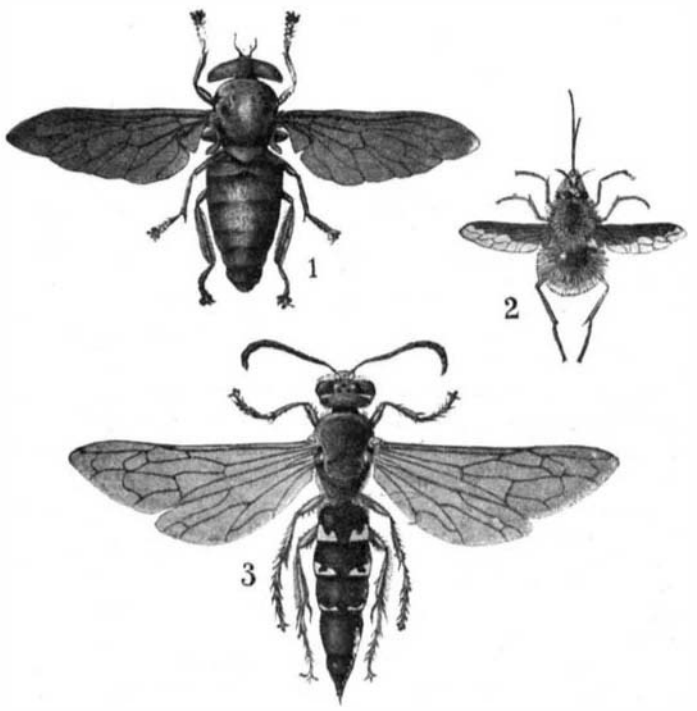
The method and mechanism of insect flight seem to have been little studied, though perhaps there is no subject relating to insects that will afford more entertainment to the investigator. It is probable that the student of aerial navigation may profit from knowing how insects fly, though the gravity differences between the man and the bug, and the principles evolved and upset thereby, are obvious. We can be more encouraged by observing the flight of the larger birds, but in the construction of wings and aeroplanes and the method of propulsion we can learn more from the insects.

In developing flight nature has adopted the very best and practically the same means for all winged creatures. With the weight-lifting downward stroke of a resisting surface is combined a slight posterior incline of the surface, and propulsion is thus gained by the wedge principle. In the uplift or regaining position of the wing there is an unresisting upper surface. This treble part is taken by the strong primary and secondary feathers of the bird's wings and by the posteriorly pliable wing membrane of the bats and insects.

The stroke of the wing is vertical and the uplift also, and this can be readily observed in slow-flying insects and birds. The trajectory of the tips of the wings, therefore, may be indicated by a series of waves, the length and breadth of which depend on the height of the stroke and the number of strokes to the speed per distance. The anterior portion of the insect wing is always more strongly braced with stout veins, and in line with the base, is the part directly operated. It is the downward stroke of this rigid part that exerts the lifting force. The posterior portion of the wing, lightly veined, and out of line of the base, is comparatively pliable. If the insect body is held horizontally the posterior portion of the wing will be observed to bend much more easily downward than upward, owing to the construction of the attachment to the body. This explains at once the means of propulsion in the downstroke and the unresisting recovery of the upstroke. In the former the slight upward bend of the posterior portion serves the wedge principle; in the latter the wing is lifted edgeways to the air resistance and has little tendency to check the forward motion of the body.

Insects present very wide differences in their wing structure, more than in any other part. From the rudimentary appendages of certain orthoptera and beetles to the great spreading wings of the swallow-tailed butterflies and giant moths there are many types and variations. The nicely balanced, high-power wings of the flies, bees, and hornets, the over-large yet perfectly controlled wings of the larger lepidoptera and the skimming, short-motion, acrobatic wings of the dragonflies will serve to illustrate modifications of wing outline and muscular control among insects with the highest wing development.

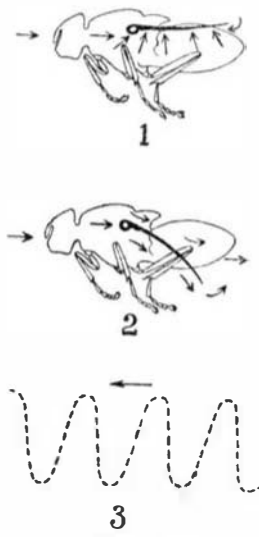
All swift-flying insects have broad wings and stout bodies, the latter to make room for the mass of muscles that is required to drive the wings at a high power. The breadth of wings must depend on the power of the muscles to drive them. In the swiftest insects there is a nice balance of muscle and wing surface. Many stout-bodied, broad-winged insects are weak flyers. Their muscles have not developed toward the control of the wings They are runners, diggers jumpers, or swimmers, and use their wings only to rise in air and drift along with the wind. Many species of the two-winged flies of the genera Musca, Tabanis, Tachina. and Bombylius, no doubt rejoice in their less complicated mechanism, for they are the swiftest of all insects. The hornets and bees, little inferior, have the shorter hind wings attached to the fore wings by a row of little marginal hooks and thus, operating with the stouter fore wings, they constitute the broad posterior development necessary for speed. The butterflies, moths, and dragon flies use their fore and hind wings separately and the posterior development of the fore wings is on or beyond the center to make room for the shorter and broader hind wings.



INSECT WINGS.

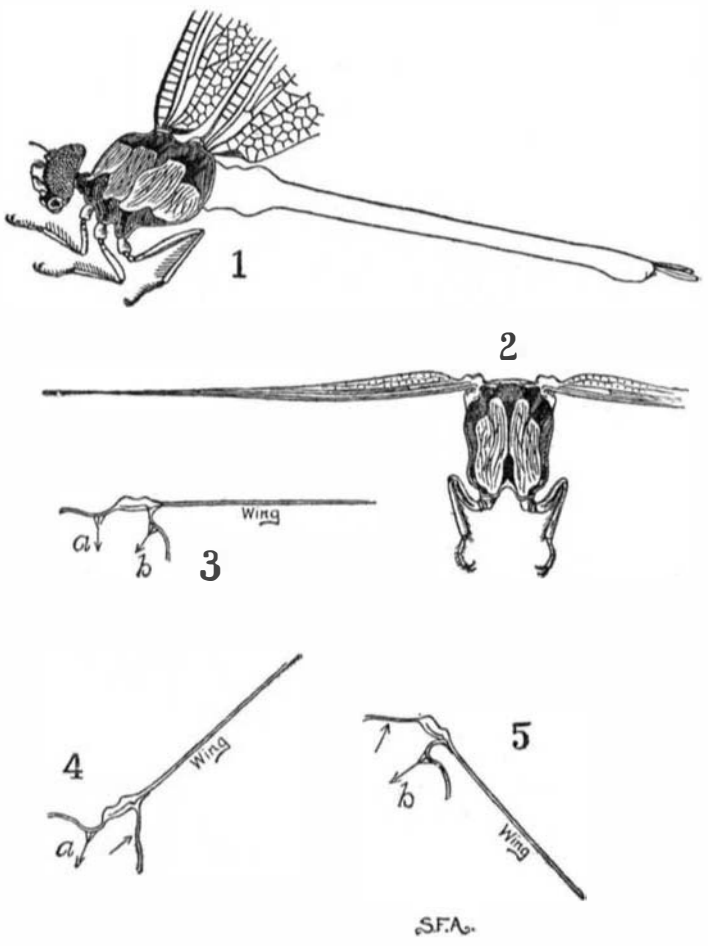
Types of the fastest-flying insects. 1.—The large black horsefly, *Tabanus atrata*. 2.—The little singing bee-fly, *Bombylius major*. 3.—The big digger wasp or sand hornet, *Sphecius speciosus*. All natural size.

The muscles of insects are pale yellowish or pinkish in color, have a somewhat ropy character, but are very soft and easily separated. The muscles that control the head, wings, and legs are contained in and nearly fill the thorax. The veins of the wings broaden at the base and are attached firmly to the tegument of the thorax which is pliable above and below the base of the wing. This attachment may be called the fulcrum. The muscles operate the pliable portions and by contracting and expanding them pull and force the wings upward and downward. In the flies the wings are attached to the side of the thorax above the center and the muscles stretch from the top to the bottom of the thorax with an arm extending to the wing. This arm works up and down upon the vertical muscles, pulling the wing from the center of its fulcrum and operating the pliable tegument, in the opposite direction from its motion. In the butterflies the wings are hinged on or a little below the center, the legs and abdomen effecting the balance. The muscle, also attached to the base of the wing, acts upon the pliable tegument above and below the fulcrum, and where it expands it appears as a mass of greater density. This apparent density works up and down the muscle; thus it will expand above and



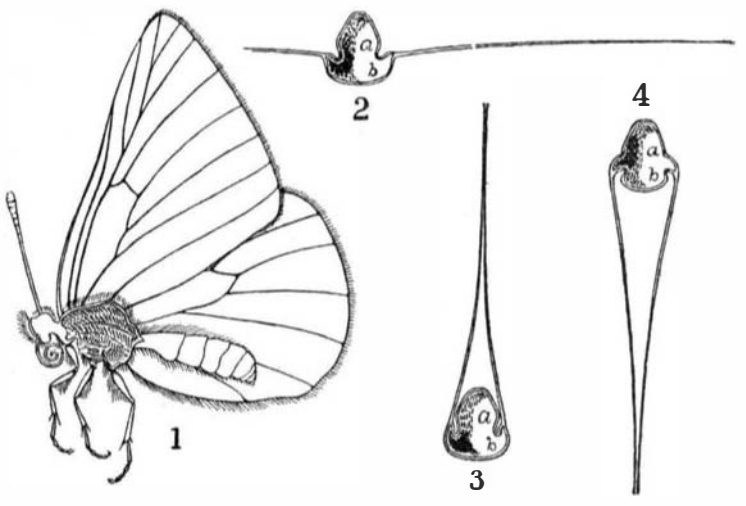
INSECT WINGS.

The middle position of a fly's wing in flying. The arrows shows approximately the resistance of the air. 1.—Downstroke. 2.—Upstroke. 3.—Trajectory of a fly's wing tip when making 300 vibrations and going six feet per second. Arrow shows direction of flight.



INSECT WING MECHANISM.

1.—Longitudinal section through thorax of dragon-fly (*Aeschna*), showing the bundles of muscles. 2.—Cross-section of same between fore and hind wings. 3.—Plan of muscular operation of wing—horizontal position—muscles pull at *a* and *b*. 4.—Same—extreme upward position in flight—muscles pull downward at *a*. 5.—Extreme downward position in flight—muscles pull inward at *b*. At the base of the wing the veins are broadened into rigid plates that are attached firmly to the pliable tegument. This is the fulcrum



INSECT WING MECHANISM.

1.—Longitudinal section of butterfly thorax showing the great number of muscles contained therein. 2.—Cross section of the same through anterior wing bases; the wings held horizontally and the mass of greatest density of the muscles being in a middle position. 3.—The wings held upright, the mass of greatest density below at *b*. 4.—Wings held downward, the mass of greatest density above at *a*. In flying, the wing motion does not reach the extremes of 3 and 4, but an angle from the horizontal of about 70° above and 58° below.

contract below and so force the wing downward. With the dragon flies the muscles are in nearly vertical bundles and the operation of the wings apparently depends only on the pull of the contracting muscles. Thus the pull on the pliable tegument between the wings brings the wings up and the pull inward, below, by a heavier set of muscles, brings the wings down. The figures serve to illustrate this far more clearly than it can be described.

Observations in the field are of most interest, and a clover field may be the chosen spot. Here will come the honey lovers, of course, and the predaceous species to prey upon them. Watch one of the big, lazy-winged butterflies soaring over the fragrant blossoms, suddenly arrested by one especially to its liking, turn or drop at right angles by a quick beat of the wings. Here are the hornets, seeking spider, cicada, or other victims and getting them by a dash almost too rapid for the eye to follow. And here is the big Aeschna dragon fly, skimming over the field like a swallow and bent upon a like quest—gnats and midges and other tid-bits whose wings are not quick enough to escape his lightning flashes. Down in the clover a musical buzz commences and quickly grows louder and higher, for a few moments constantly ascending the scale. This is Bombylius, the little yellow, fuzzy, bee-fly, and in the hope of finding him we have brought along a handy little instrument. Now quickly striking a note in tune with its wings we find that the fly's limit is reached at G, above middle C. Musca, the house fly, is credited with 330 vibrations of its wings per second. This corresponds to the note of E in the octave below middle C. But the little bee fly attains nearly 800 vibrations, incredible as it seems; and as the upstrokes hardly resist air sufficiently to occasion sound, it is probable that this means 800 down strokes per second. And there are other flies of the Tachinidæ and certain small Andrenid bees that vibrate their wings at a like tremendous velocity.

DASTARDLY ATTEMPT TO WRECK THE "CONNECTICUT."

In connection with the building and launching of the battleship "Connecticut," there has been perpetrated a crime which, not many decades ago, would have subjected the culprit to the death penalty. We refer to the persistent and pernicious attempts made to wreck that ship, which were only discovered through the careful vigilance of those in charge of her construction. The first attempt was discovered over six months ago, during an inspection of the work already done on the ship; the second on September 14 last, when the divers were making an examination of the under-water portion of the launching ways to see if everything was in good shape for the launching; and the third effort was discovered on the day of the launch, fortunately before any injury resulted to the ship. The various attempts bear strong internal evidence of the fact that they were made by a skilled operator who was thoroughly familiar, not only with the use of shipbuilding tools, but with the conditions attending the construction, inspection, and launch of such a ship as this. The portions of the ship attacked, and the means taken to wreck her during the launch, show that the guilty party or parties understood perfectly well what portions of the ship to attack and what means of obstruction to use, if they would evade the very searching inspection to which a warship is exposed during her construction and launching.

To understand the cunning way in which the attack was planned, it must be understood that, during her construction, the weight of the vessel was carried mainly by three longitudinal and continuous lines of support, namely, a center line of keel blocks, extending practically for the whole length of the vessel, immediately below the keel, and two sets of launching ways located on each side of and parallel with the keel blocks, at a sufficient distance therefrom to give a fairly even distribution of the weight of the ship during construction and to provide sufficient lateral stability when the vessel is carried by the launching ways alone during her passage down into the water. During her construction, every part of the outside of the hull of a ship is open to inspection, except that which is covered by these three lines of support; and should any hole be drilled in the bottom, on the exposed portion of the hull, it will be certain of detection. The criminals who attempted to injure the vessel decided, therefore, to drill through her hull where it rested upon the keel blocks and sliding ways. The first attempt, discovered on March 31, was made in compartment B-87, and immediately against the vertical keel of the ship. This compartment forms part of the cellular double-bottom and the fellow who did the work was therefore in a very remote and secluded place, where, with an accomplice to give him warning from the manhole that led into the compartment, he might easily carry out his job without immediate detection. For his attack he chose two of the ⅞-inch rivets which pass through the flat outer and inner keel plates. First, he chipped off the heads of the rivets on the inside of the ship; then he drilled a ⅝-inch hole centrally through each rivet, so that it could be easily driven outward; and then, either by means of a brace, or by using a hydraulic jack set up against the under side of the inner bottom of the ship, he drove these two rivets out of the plating and into the soft wood of the keel block. Here, then, were two ⅞-inch holes clear through the ship, with the outside of them concealed by the permanent blocking, and safe against detection. No doubt it was imagined that among the million of rivets throughout the whole ship, these two missing rivet heads would escape detection until the ship was afloat.

Upon the fortunate detection of this attempt, the party or parties determined upon a more deadly plan, namely, that of wrecking the vessel during the delicate operation of launching. To effect this, they selected a spot several feet below low water mark, on the smooth, inclined surface of the starboard launching ways, over which the sliding ways pass when the ship is being launched, and drove into them at about the center of their width a bar of 1⅜-inch round steel, leaving some six inches of the bar projecting above the ways. This seems rather an inadequate obstacle to place in the way of an object weighing 7,000 tons, that is moving down-grade, with a speed, say, of 8 or 10 miles an hour, and it is probable that when the ways struck it, the bar would have been bent over and flattened down into the permanent launching ways and the vessel would have passed safely over it. At the same time it is entirely possible that it would have had sufficient resistance to split the sliding ways, and cause a crumpling up and disarrangement of the timbers, that would have slewed the ship and caused her to bind upon the ways, stopping her progress. If so, she would probably have come to rest with one-half of her bulk on the ways, and the other half hanging out in the water. This would not have hurt her so long as it was high tide and the hull was water-borne; but as the tide receded the support of the after half of the vessel would have been removed, and the enormous bending strain thus set up would have seriously strained her hull, if, indeed, it did not cause it to break entirely in half. Fortunately, the divers found the obstruction, and the piece shown in our engraving was sawn off flush with the ways, leaving the other part of the bolt imbedded.

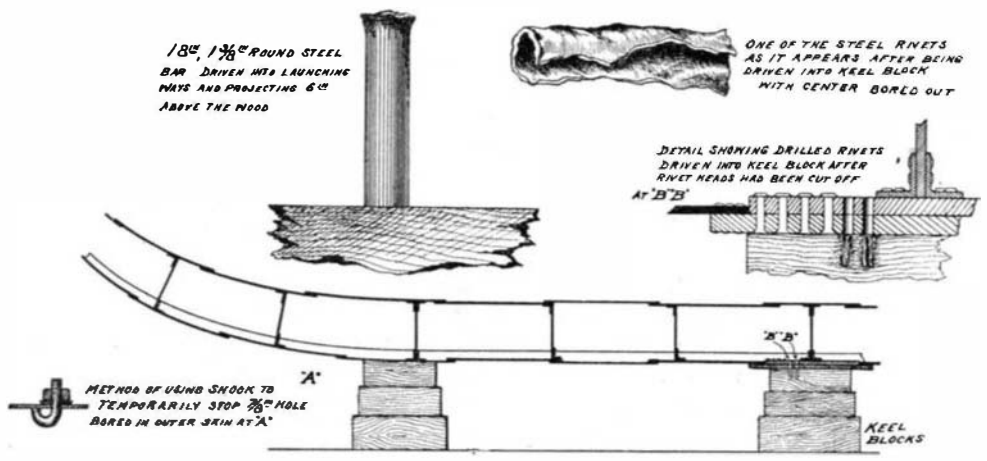

1⅜" ROUND STEEL BAR DRIVEN INTO LAUNCHING WAYS AND PROJECTING 6" ABOVE THE WOOD
ONE OF THE STEEL RIVETS AS IT APPEARS AFTER BEING DRIVEN INTO KEEL BLOCK WITH CENTER BORED OUT
DETAIL SHOWING DRILLED RIVETS DRIVEN INTO KEEL BLOCK AFTER RIVET HEADS HAD BEEN CUT OFF AT "B"B'
"B"B'
"A"
METHOD OF USING SHOCK TO TEMPORARILY STOP ⅞" HOLE BORED IN OUTER SKIN AT "A"
KEEL BLOCKS

DIAGRAM SHOWING METHODS ADOPTED TO WRECK THE "CONNECTICUT."

The third attempt was discovered on the day of the launch, after the ship was afloat, when it was found that water was entering compartment B-88. As soon as the water was pumped down, it was found that a ⅞-inch hole had been drilled through the skin plating of the ship, at the point where it rested upon the launching ways. Upon its discovery the hole was temporarily closed by inserting a hooked bolt of the kind shown in our drawing, provided with washers and a nut, which was screwed down firmly from the inside, forming a water-tight joint. Permanent repairs will be made when the vessel goes into drydock.

The intelligence and skill with which the attempts on the ship were made, made it evident to the authorities that they had to deal with a culprit of no mean ability, and orders were immediately given to subject the ship to special surveillance, even to the extent of having special arc lights placed around her from dark to dawn, and setting up a searchlight on one of the adjoining ships to sweep the water in her neighborhood during the same interval. To the lay mind, it will, of course, appear to be an extraordinary thing that such dastardly attempts on a United States vessel should be repeated under the very eyes of the officials who are responsible for her safety. But it must be remembered, on the other hand, that the wreckers chose just those very methods of operation which would bear the appearance to the official eye of being part of the regular workmen's duties. During the construction of the ship there are hundreds of men at work with chipping hammers and drills. Also with regard to the attempt on the launching ways, it would be possible for any one of the divers who was sent down to do work upon these ways, to drill the hole and with a few strokes of the hammer drive in the iron bar. The crime, in regard to the difficulty of detecting it, was as easy of performance as the misplacing of a switch or a signal in an attempt at train wrecking.

It is sincerely to be hoped the man or men who did this work will be brought to the severest justice that can be dealt to them. Speculation as to who the guilty parties are, and what their motive, is idle. But it is generally supposed to be either the work of some disgruntled workman, or of some demented person with a mania for wrecking the ship. It is also remembered that in the earlier stages of the construction of the vessel there was trouble with the labor unions, some of whose representatives had to be forcibly expelled from the navy yard. The indignation among the workmen employed on the ship, who as a body have taken the greatest interest in her construction, is unbounded, and it is probable that from the men themselves the clews leading to the detection of the wreckers will be obtained.

Roman Forum Excavations.

One of the most important finds which has been made lately by Comm. Boni in the Roman Forum is that of a tomb which dates back to the foundation of the city. It is one of the most ancient of all the late discoveries. The excavation was made in a spot which had not been touched before, a few square yards of ground under the Temple of Antoninus and Faustina, near the Arch of Septimius Severus. Below the foundation of the temple Comm. Boni found six different layers of ground. The last layer covered a slab of greenish-gray tufa which was broken in several fragments. Under the stone lay a great vase or pot (*dolium*), at the bottom of a shallow pit. The *dolium* contained nine different vases, one of which was an *olla* filled with calcined bones. There was no doubt that they had uncovered a burial place. The main containing vessel, or *dolium*, is a vase or pot of unusual size; the material is of red terra cotta. It is very thick and seems to have been made by hand and polished with a spatula. The vessel is burned in several places and blackened in others. It measures 17 inches in diameter at the top border, 21 inches in the middle or largest part, and 10 inches at the bottom. It has a cover of tufa stone which is rounded and resembles a tortoise shell in form. The *olla* or pot containing the bones is relatively small and is 10 inches high. It is also made of red clay, but of a more careful workmanship, with an overturned border and lugs or ears which are provided with rings. The cover of this pot has the form of the roof of a Latin cottage or hut. The *olla* contains the remains of a body which had been burned on a funeral pyre, with debris of half-burned bones and fragments of skull. Dr. Roncali estimates that the individual was about thirty years old. Around the burial urn containing the bones which occupied the center of the *dolium* were disposed the different vases and other objects which were buried with the dead as in the usual case. These latter objects are modeled of a blackish earth and formed by hand. Their surface is finished by strokes of the spatula. The objects comprise two pots for containing preserved food with strokes in relief to imitate the basket-work with which the ancients protected such vessels; a *poculum* (goblet) channeled on the surface, which probably had a wood cover originally, but the latter had rotted away; a lamp of the usual flat form, a large cup and three small cups with handles. These objects recall the specimens of the same kind which have been found in the most ancient tombs of the Alban burial grounds and elsewhere. They resemble those of the Velletri and Ardea sepulchers, also those of Tarquinia and other Etruscan cities. On this account the present find is of the greatest interest on account of the place where it was located. There seems to be no doubt that the tomb dates from the period of the foundation of Rome. When the Forum became the center of the city such burial places were no longer allowed.

The coal transporter at Rouen, connecting the river Seine with the docks, is 600 feet in length, and has a raised platform 50 feet in height on the quay side of the river and 30 feet on the dock side. This transporter, which is said to be the largest in the world, is supported by three arches, sliding on rails, and under the wagon is suspended a huge bucket, capable of holding 32 hundredweight of coal.

Correspondence.

"Cyclone" or "Tornado."

To the Editor of the SCIENTIFIC AMERICAN:

In your current number appears an article criticising my description of a storm disaster in Minnesota, in which the writer takes exception to my use of the word "cyclone," and makes the statement: "It should be scarcely necessary to say that a cyclone is not a tornado, but is one of those widely distributed circular storms which are constantly sweeping over the earth's surface."

Permit me to say that I used the word "cyclone" advisedly, and not without a clear definition of its meaning as differing from other storms. The generally accepted definition of the word as given in the dictionary and encyclopedia is "a violent storm of wind rotating around a calm center." While no meteorologist or other expert observer witnessed the one at St. Charles, its cyclonic character was marked in several distinct ways. At the same time it could be termed a tornado as well, since, according to the same authorities, it is a form of cyclone, only on a more limited scale.

The critic takes the ground that a part of the damage was probably caused by air pressure from the interior of the buildings, and gives an interesting theory in support of his argument. I referred to this in describing the wreck of the grain elevator. Here the downward suction of the air current apparently produced a centrifugal motion, which removed or forced out most of the grain. The cause of the damage, however, was the storm of air current, which by its force doubtless in several instances caused what might be termed interior atmospheric explosions, causing partial vacuum without. DAY ALLEN WILLEY.

Baltimore, Md., September 8, 1904.

Effect of the Sun on the Black Race.

To the Editor of the SCIENTIFIC AMERICAN:

As regards the "effects of the sun upon the black race," as discussed by Prof. E. G. Dexter in the SCIENTIFIC AMERICAN, August 20, he has, in my estimation, overlooked a very important factor, which is found in the laws of evaporation.

In *prima facie*, Prof. Dexter's argument seems well founded, viz., that a heat-absorbing complexion should for the reasons given be placed by compensative Nature in cold climates, and *vice versa*. When we come to study this subject more deeply we find that though a black skin may serve to elevate the normal temperature of the body in the already overheated tropics, the inconvenience so caused would not be near so great as that caused by the evaporation of the body's moisture, which must necessarily rob the latter of its nervous heat. Whatever physical distress or loss of energy may be due to tropical heat seems explainable as follows: In the first place, since the humid atmosphere causes profuse perspiration, the temperature of the body will be lowered very much, so that a greater difference must exist between itself and the surrounding air or sun. This condition gives rise to the nervous sensation of "burning," but it is really a delusion, for the body is not at all overheated. Nevertheless, it would be unjust to say that because the body temperature is low, the nerves are not actually burning. Forsooth, their stimulus is absorbed by water-evaporating skin more rapidly than it can be replenished. And this causes the lassitude with which we are so familiar.

Wise Nature, being aware of these difficulties, seems to show its foresight by not only salting the sweat to decrease its volatility, but it so colors the skin in the tropics that much of the heat required by the inevitable laws of evaporation is abstracted from the sun instead of the body. ALBERT F. SHORE.

Brooklyn, N. Y., August 20, 1904.

Lessons of a Railway Wreck.

To the Editor of the SCIENTIFIC AMERICAN:

There are some possible lessons in connection with the disastrous wreck which occurred on the Southern Railway near here last Saturday which may not be noticed farther away, where the details are not so well known. The west-bound train consisted of a light engine and three ordinary coaches, running at a rate estimated at 40 to 50 miles an hour; the east-bound one had a much heavier engine, drawing a mail and baggage car, two day coaches and three Pullmans, the latter, as usual, being on the rear end. It was running about 30 miles an hour. Of the 60 or more persons killed, all were on the east-bound train, except the engineer and fireman of the west-bound. Not a person in the Pullmans was seriously injured. It would seem that when the light train struck the heavy one it was simply thrown to one side (the meeting was on a curve), throwing the cars about in a way dangerous to life and limb, but not crushing them more than would be the natural consequence of throwing them about so. On the other hand, the force of the blow stopped the heavy engine of the east-bound train, while the three heavy Pullmans in the rear came on with a force which crushed the four cars ahead of them as though they were but chicken coops. With an immovable engine ahead and such tremendous energy coming on behind, it came near being an exemplification of the irresistible force striking an immovable body, with those cars serving as a buffer. The fate of the buffer in such cases may be imagined when it is remembered that from one of these coaches only two persons are known to have escaped alive.

Orders will be forgotten or disregarded as long as trains are run by mere human beings, and so there will be no end of collisions. The public has long known, and if I mistake not the SCIENTIFIC AMERICAN has pointed out, that the Pullman car is the safest on the train, usually escaping except from rear-end collisions, and then suffering little if any worse than the lighter coaches before them. Those who can afford them will continue to ride in them, for the added safety as well as comfort; but may not the day come when that part of the public that travels on a cheaper scale will demand that railroad companies cease to make a buffer of it to place between the obstructions on the track and its high-priced traffic riding in the bomb-proof Pullmans? W. C. CLARK.

Rutledge, Tenn., September 29, 1904.

The Black Race.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 20, Prof. E. G. Dexter asks why the black races have been "placed" in the tropics where they are most affected by the sun's rays, instead of near the poles, and he seems to look to some other science than physics for an answer to this query.

According to the now generally-accepted theory, pigmentation is produced by the sun's rays or rather by the heat produced by the sun. Now, geology teaches that our earth was a very hot place when organic life first made its appearance upon its surface, and there is every reason to suppose that man appeared upon earth at a period when the coolest place upon it (where man undoubtedly first made his appearance) was a great deal hotter than the hottest place at the present time. Consequently, the first human race must have been a black race (which, however, is far from saying that it was a negro race)—blacker, perhaps, than any race now existing. The bleaching process which has been going on through the ages, is in strict conformity both with the law referred to by Prof. Dexter, namely, that a white surface absorbs less heat from the sun than a dark surface, and the well-known fact that not only the human skin is fairer in cold climates than in warm climates, but even animals and birds have lighter covering in the former than in the latter; for as animal life first made its appearance in a higher temperature than that under which it now exists, the phenomenon under discussion is in strict accordance with the law of adaptation to the environment, and not a contradiction "between a fact in nature and a natural law," as the professor seems to think, erroneously assuming that sunlight is an "evil" even in the tropics, the fact being that it is the greatest blessing nature has bestowed upon our planet, and without which organic or animal life could not exist.

Pigmentation, then, may be explained as Nature's effort to absorb as much as possible of the greatest of all earthly blessings, and the loss of it, as the accentuation of the evil resulting from yielding too readily to conditions which tend to deprive one of it. The black man has "placed" himself in tropical countries because life there is sustained by the minimum of effort, the least expenditure of energy, while the loss of pigmentation and consequent decrease in the absorption of heat resulting from living under a lower temperature is Nature's way of warning man not to expend energy too fast by seeking his abode where less sunlight and heat makes life more strenuous and exhausting. When the majority of the human race have chosen or have been forced to live under such conditions, the increased struggle for existence has indeed brought them the blessings of civilization; but the development of intellect resulting from this struggle has generally been at the expense of the physical perfection—health and strength, if not beauty—enjoyed by black races.

Except for the constant infusion of dark blood into the white race, thus retarding the bleaching process, this race must long ago have become extinct.

The professor is right in intimating that one science should corroborate the truths discovered by another, and if he will dip a little more deeply into other sciences than his own specialty, he will find that there is not even "a seeming contradiction between a fact in nature and a natural law," though the above brief explanation of the object of pigmentation in the black races may not at first glance seem satisfactory.

Chicago, Ill., August 22, 1904. O. M. PETERSON.

Kapok and Its Uses.

Chambers's Journal contains the following:

Every year that busy center of commerce, Amsterdam, receives nearly 1,000 pounds' weight of a curious and interesting vegetable substance known in Java and in the trade as kapok, which is found very useful for stuffing cheap mattresses and pillows, among other purposes. It is a sort of yellow wadding which nature uses as a covering for the seeds of certain trees in the Malaccas. Its fibers being very non-resisting, it has been found impossible to spin or weave it, but it gives excellent results for bedding, making a mattress delightfully soft if it is exposed to the sun before being used. It is exceedingly light and buoyant, in this respect greatly surpassing cork, as it will support in the water thirty-five times its own weight. The tree whence it is derived (*Eriodendron*) grows rapidly, and in the second year is 12 to 15 feet high, but it does not fruit abundantly until the fourth year. Like the cotton plant, it bestows two gifts on man—the special wadding mentioned, which lines the husk, and the oil extracted from the seeds, which is used especially in the Chinese markets. The threads of the soft fiber taken from the pods are light yellow, rather silky, and only about an inch in length. They are made into thin rings. Kapok, it is said, never decays. Among the ever-increasing uses to which this curious vegetable product is put—causing the culture of the Eriodendron to make great strides in the Dutch Indies, while efforts are being made to cultivate it in similar climates—it has been suggested that excellent life-saving apparatus might be made from it, which should be in the form of mattresses and cushions, easily obtainable in moments of danger. Three hundred grammes of kapok (10½ ounces) will support a man of 10 stone 5 pounds (145 pounds) in the water; and experiments by a French society with articles made of this wadding, which had previously been soaked in water for eighteen hours, gave excellent results. One small mattress supported several men. It is probable that soon all ships' beds will be made of kapok.

The Current Supplement.

The Eighth International Geographic Congress forms the first-page illustration, and some interesting portraits of distinguished scientists are given. An electrical heating apparatus of a new type and its application to the baking of bread are described. The future historian of the progress of telegraphy and telephony in America must devote much space to the invention of the telegraphic relay. Dr. John Trowbridge discusses the subject in the current SUPPLEMENT, and seems to think there is a prospect of the relay's practical use in telephoning. Prof. Edward S. Holden, librarian of the United States military academy, contributes a scholarly article on Copernicus. Two articles from the pen of the St. Louis correspondent of the SCIENTIFIC AMERICAN are published, the one on the French pavilion and gardens at the fair (an excellent replica of the Grand Trianon at Versailles); the other on the mining exhibits at the fair, describing a typical gold concentrating plant. Prof. Dr. R. von Lendenfeld writes a very thorough article on climate and glaciers. Still another article of meteorological interest is one by Dr. W. N. Shaw, F.R.S., on the "Mechanics of the Atmosphere." Scientifically considered, one of the most important contributions of the current SUPPLEMENT is the first installation of a splendid article by Prof. E. Rutherford on the "Radiation and Emanation of Radium." The article considers the subject in the light of the most recent research and describes experiments made with radium.

In Knowledge, Mr. R. Lydekker traces the "Later History of the Horse," and endeavors to decide between the alternative theories of its derivation from those primitive breeds, when, as Mr. Kipling says in the "Just So" stories, the horse followed the dog in becoming the friend of man. There is, says Mr. Lydekker, decisive evidence of the existence in Egypt in 1900 B. C., or earlier, of a long-maned breed of Arab horse totally unlike the wild tarpan or the prehistoric horses familiar to the cave-dwellers of La Madelaine. Such a breed must have been the result either of a long antecedent domestication, or must have been produced from a wild species furnished with a long mane and tail. Probably the former view is correct so far as the development of the mane and tail is concerned, although it is most likely that the breed traces its origin to a species distinct from the tarpan and prehistoric horse of western Europe. That such a breed should have been introduced into Germany and Britain in pre-Cæsarian times—at all events, in such numbers as to obliterate all traces of crossing with the wild horses which abounded in those countries during that period—seems to him in the highest degree improbable; and he therefore cannot at present see any valid reason for refusing to credit the view of Flower that in Palæolithic and Neolithic times the indigenous hog-maned wild horses were domesticated by the aborigines.

THE "CIRE-PERDUE" PROCESS OF BRONZE CASTING.

In very many of the artistic sciences and crafts we in this country are still behind the Europeans. That this is the case is of course easily explained by our comparatively short national life and the fact that the artists and craftsmen of the Old World have been perfecting themselves and developing the processes of their sciences for hundreds and sometimes thousands of years. In the casting of architectural and art bronzes is this generally, and with truth, believed to be the case. It has only been within a few years that we have been able to approach the French, Italian, and Russian bronze work. Even to-day work that can fairly be considered the equal of any done in Europe is accomplished by but few firms in this country; and the success of these companies is entirely due to the introduction of the "cire-perdue" process of making bronze castings. This process, while it has been in use in Europe for hundreds of years, was not introduced in the United States until about a decade ago.

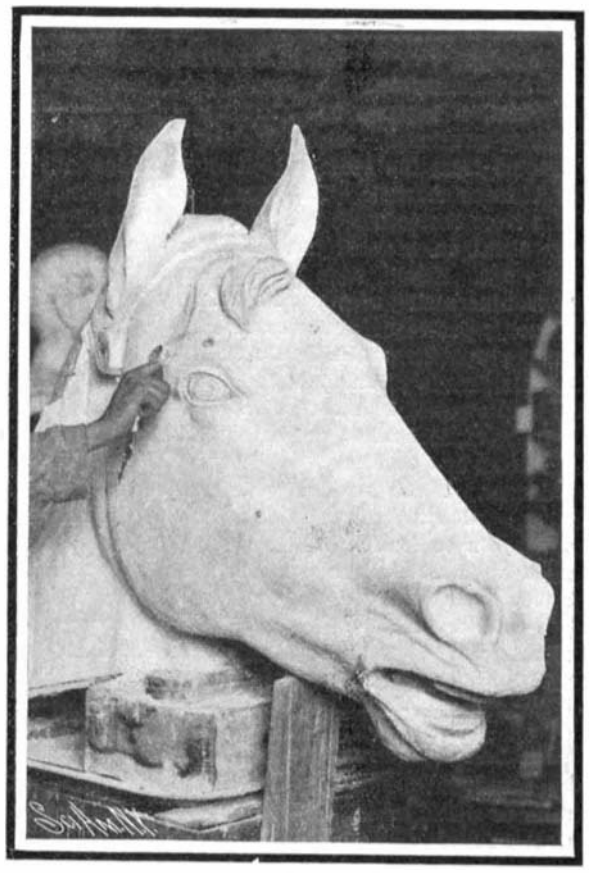
While a similar though much cruder method was in use by the ancient Greeks and Romans, it was developed to essentially its present state by the great Florentine goldsmith and bronze worker, Benvenuto Cellini, about the middle of the sixteenth century and has remained practically unchanged to the present day.

The "cire-perdue" process differs radically from the common or sand casting in several ways, and the latter can in no wise compare with it. Its principal advantage is that no matter how complicated or involved the original may be, the bronze reproduction can be cast in a single piece. This does away with assembling the separately cast bronze pieces, with the consequent inevitable traces of the joining. Further, there is no tamping of sand in the mold, with the danger of destroying detail, and finally, a complete casting takes about half as long to make by this method as by the other.

Though the sculptor usually carries out his conception in clay or wax of the same size as the intended bronze, it is sometimes inconvenient, especially if the statue is to be of heroic size, to do this, and consequently the artist's original is frequently much smaller in size. As, however, full-size plaster casts are necessary in this or any other process of bronze casting, a full-size clay model must be constructed from the small original. The illustrations show the manner in which the whole or the parts of a model are enlarged.

When the original or plaster replica is received from the artist, the first step in the "cire-perdue" process is to make a plaster or gelatine mold or "negative." Within this negative a hollow wax figure or positive is now built up, the wax being applied with a brush till it is of the thickness that the finished bronze is to be. This part of the process, as is easily seen, is analogous to sand molding, and the wax figure must be made in separate pieces whose size and number are determined by their shape; for instance, if a half-closed hand is to be molded, the fingers and the body of the hand would have to be separately reproduced and afterward assembled, as otherwise it would be manifestly impossible to remove the pattern in one piece without destroying the mold. The analogy ceases with the assembling of the separate wax pieces. The complete figure is retouched as much as necessary, and, as the medium is wax, by using heat in the assembling the joints can be absolutely done away with, so that we have an exact wax likeness of the artist's original. A great advantage of this method is that, if he desires to do so, the artist can change or retouch the wax figure as much as he pleases. The wax is sufficiently hard to permit handling, and will take the most delicate impression.

The next step is the making of the final mold for the metal. This is made of a composition, liquid in form, that hardens in a few minutes after its application. This composition is poured around the wax figure and, as can be easily understood, makes as exact a mold as can be produced, and, moreover, entirely without ramming or tamping. At the same time an outer shell of a coarser composition is built up around the mold to give it greater strength. An opening or two is left in the hollow wax figure so that the composition may be poured into it to form the inside core. Bronze rods are driven through the wax at several places, projecting on the inside as well as



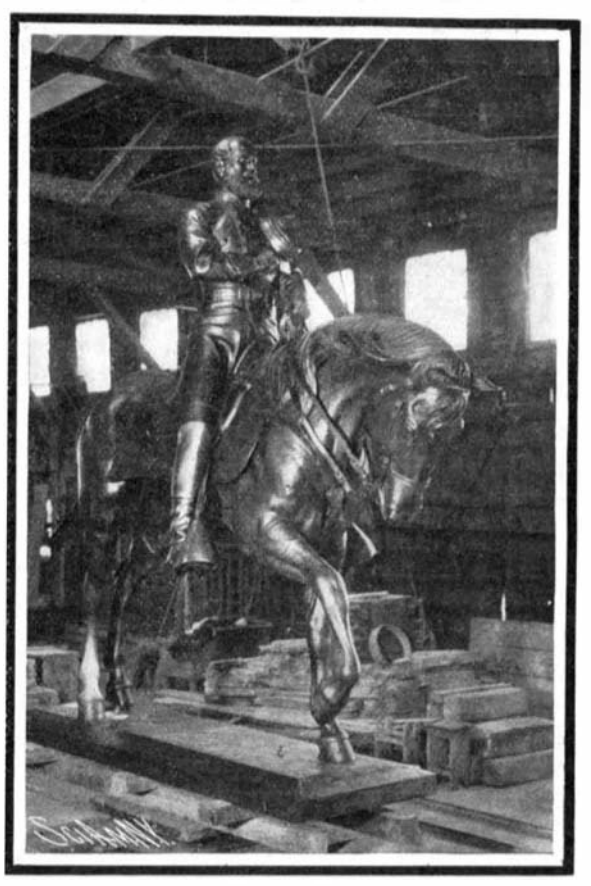
Retouching Plaster Model.

Finishing Model of General Porter.

Putting on Channels, Gates, and Cores.

Sand Molding.

Completely Assembled Wax Positive or Pattern.



Finished Bronze.

THE "CIRE-PERDUE" PROCESS OF BRONZE CASTING.

the outside, in order to hold the outer and inner cores in their proper relative positions on removing the wax. Before the completion of the outer core, wax rods or bars, that later form channels for the metal or vents, are attached to the wax figure wherever necessary, all leading to one main channel in the upper end of the mold. The enveloping of the figure with the composition is now completed, and the mold placed in an oven and baked over a slow fire. Under this treatment the wax runs out, leaving a mold of the complete figure, while at the same time the composition hardens. The mold is now ready for running the molten metal.

The casts come from the mold in an almost perfect condition, the minutest detail being as clear and distinct as if chiseled by hand. Beyond removing the channels and vents, which of course have been filled with metal, and brushing off the particles of the hardened composition with a stiff brush, the figure requires no attention other than the usual final coloring or patining, which is done with acids and chemicals.

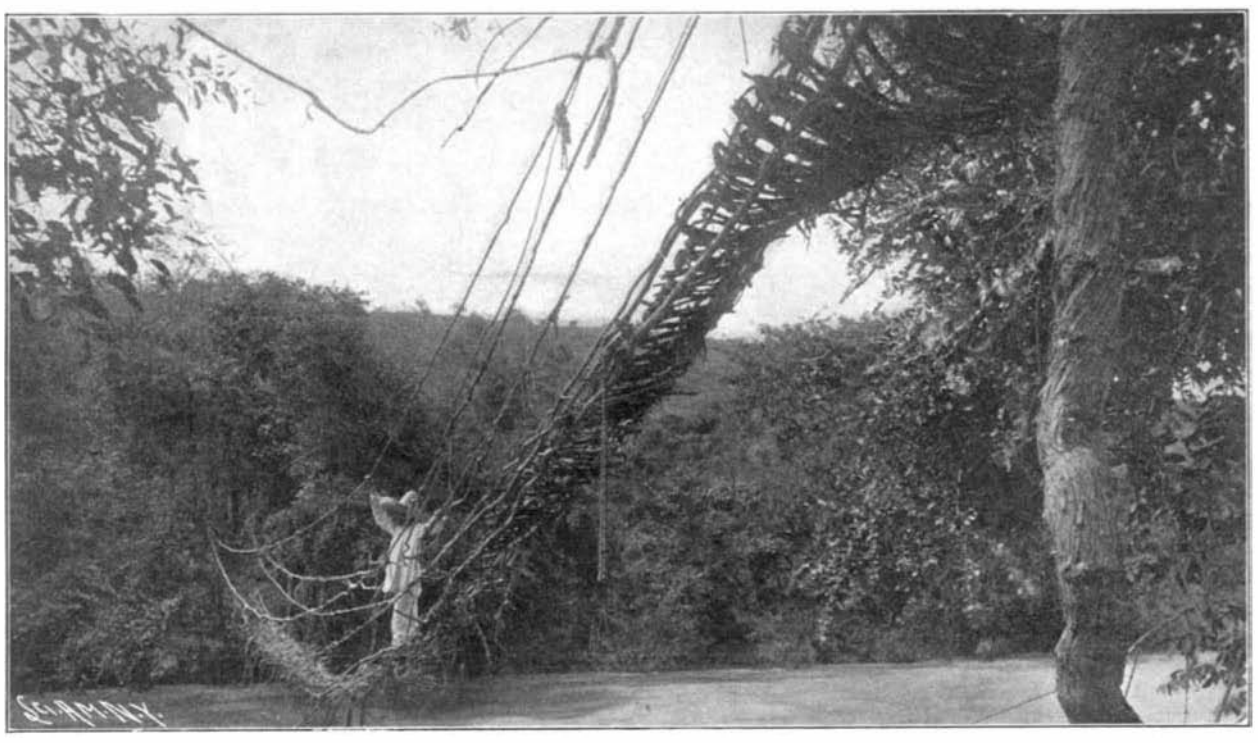
In the "Cire-perdue," freely translated "lost wax," process as used by the Greeks and Romans, an inner core was made roughly of the desired shape and covered with a layer of wax. In this wax the artist modeled the figure and then the outer core was put on surrounding it. The mold was then baked, the wax melting out, and the metal run in. While this made an exceedingly good bronze of the artist's conception, it did not permit of making more than one and was consequently impracticable for modern use, till the genius of Cellini developed the process to its present state.

For the information contained in the above account, we are indebted to the courtesy of the Roman Bronze Works, of Greenpoint, Brooklyn.

A NOVEL SUSPENSION BRIDGE.

BY CHARLES B. HAYWARD.

That "necessity is the mother of invention" is seldom better exemplified than in the case where man is confronted with an engineering problem with nothing but nature's tools—his hands—to solve it. Great praise has been forthcoming for the genius whose brain evolved the plans of such a bridge as the New York and Brooklyn suspension bridge; but would that same skill, which, aided by every facility possible, has produced such massive and well-sustained monuments of stone and steel, be equal to the emergency if confronted by the same problem, though on a diminutive scale, a thousand miles from a machine shop and possibly a hundred from a hammer and nails?



A NOVEL SUSPENSION BRIDGE.

This, however, is the position of the natives in many parts of Mexico and Central America, where fairly wide and rapid-running streams are so numerous that even in some of the miniature republics above the isthmus their water power in the aggregate might compare favorably with that of Niagara. They are never dry and seldom fordable; when swollen by unusual rains they are often absolutely impassable for weeks except by a lofty bridge, and this the native has provided alone and unaided.

The tropical forest supplies lianas of every imaginable length and diameter, from the quarter-inch tendril to the vine with the girth of a man, and all, barring flexibility, with practically the same properties as steel cables. These, with a little rope and the boarding required for the footwalk, which is also supplied by the trees at hand, are all that are required. Work is begun without any controversy as to eyebars or suspension cables, and within a month, more or less—for there is never any hurry—the completed suspension bridge will be gently swinging in the breeze, unique in its freedom from iron or metal fastenings of any nature. A glance at the one shown in the accompanying illustration reveals the fact that, with the exception of anchorages, which are entirely lacking, all the principles of the suspension bridge as known to modern practice are in evidence. Stout trees are utilized as towers and form the bridge's sole support. The work throughout is done in the crudest manner, and as a rule one must mount several feet into a tree in order to begin the journey. To the uninitiated a trip across one of these bridges is not always an unalloyed pleasure, for it sways uncomfortably, sinks with any weight to a rather alarming degree, and the creaking and groaning of its members are far from reassuring. Nevertheless, they are built to last and are not temporary in any sense, occasional repairs being sufficient to maintain them for years. Needless to add, the capacity of one of these bridges is limited to man and his burden; a four-legged animal would have a difficult time crossing.

EXHIBITS IN THE BOILER HOUSE AND THE PALACE OF MACHINERY, ST. LOUIS.

BY THE SPECIAL CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The purpose of the collection of exhibits in the Palace of Machinery and in the Boiler House, officially known as the Steam, Gas, and Fuel Building, is to show, first, the modern methods for developing and using power, and secondly, the machinery and apparatus used in making machines.

The Power House and Machinery Building, in spite of the serious omission of several large European gas engines and producers that were contracted for but failed to materialize, is a most interesting field of study. The total fuel consumption averages somewhat over 400 tons per day. To insure that the requisite amount of fuel should be on hand, the Commissioner purchased 170 fifty-ton coal cars, which bring the coal direct from the mine to the power house. In order to provide against mishap, a large number of loaded cars are maintained at all times on the sidings, so as to insure that there shall be several days' supply of fuel on hand.

It is a significant fact that the whole of the boiler installation is of the water-tube type. First we have sixteen Babcock & Wilcox boilers of 400 horse-power each. Then follow the eight Heine boilers, which are also of 400 horse-power. Aultman & Taylor are represented by sixteen boilers, eight of them of 500 horse-power, and eight of them of 400 horse-power. Durr is represented by a 700-horse-power boiler that can carry 1,200 horse-power; Niclausse is represented by two 800 horse-power boilers that can carry 1,000 horse-power; Belleville has three boilers of 500 horse-power; Clonbrock one 300-horse-power unit of the marine type and one 250-horse-power stationary boiler. The most modern boiler in the whole installation is a Schuette boiler of 500 horse-power, manufactured at Stettin. In addition to the boilers themselves there is, of course, all the concomitant plant in the way of blowers, pumps, etc., that is necessary for the running of the plant. Some of these, however, have received separate treatment in this journal and need not be enumerated at the present writing.

To the second object aimed at by the Commissioners in charge of the Machinery Building, namely, the exhibition of machinery and apparatus used in making machines, about two-thirds of Machinery Hall is devoted. With a few exceptions the exhibits to accomplish similar results are found grouped in and about certain well-defined locations. Thus, means for guiding and controlling the flow of water, steam, and gas are located along or near the northerly wall of the building. Next, and toward the south, are machines for cutting and forming metals; the range of this assortment extending from the huge machines used in ship, engine, and car works, down to the pigmy tools used in watch making. Instruments which will measure to one ten-thousandth part of an inch and tools which do work so accurate as to require such refinement in measuring are here exhibited.

Toward the center of the building, power punches, presses, metal-bending and shaping tools, and forge shop requirements are grouped. Adjacent to these on one side is a fine display of abrasives and machinery for using abrasives. Next on the opposite side are pumps, air compressors and water meters. Beyond these are the gas and gasoline engines, a display which is good as far as it goes, but for reasons above stated gives an altogether inadequate idea of the remarkable development of the art as reached in Europe. To the east of the gas engine department is a collection of belts, pulleys, hangers, and shafting; and then follow hoisting engines, winches, and other apparatus and appliances for lifting heavy bodies. In succession follow pneumatic tools and appliances, fire hose and fire escapes and miscellaneous machinery, until the very interesting woodworking group is reached in the southeast quarter of the building, where several machines may be witnessed in operation.

Within the scope of the present article it is impossible to give any detailed account of the numerous exhibits; that has been and will be done in various illustrated articles in this journal. In the present connection we show a series of views taken in both the Boiler House and the Machinery Building. The Westinghouse Company exhibit a Parsons turbine direct-connected to a 400-kilowatt generator. Though it is a comparatively small turbine compared with the powerful units that this company is building for power station service, it is thoroughly typical of this very interesting development in prime movers. The turbine is running at a speed of 3,600 revolutions per minute and delivers a three-phase, 60-cycle current at a potential of 440 volts.

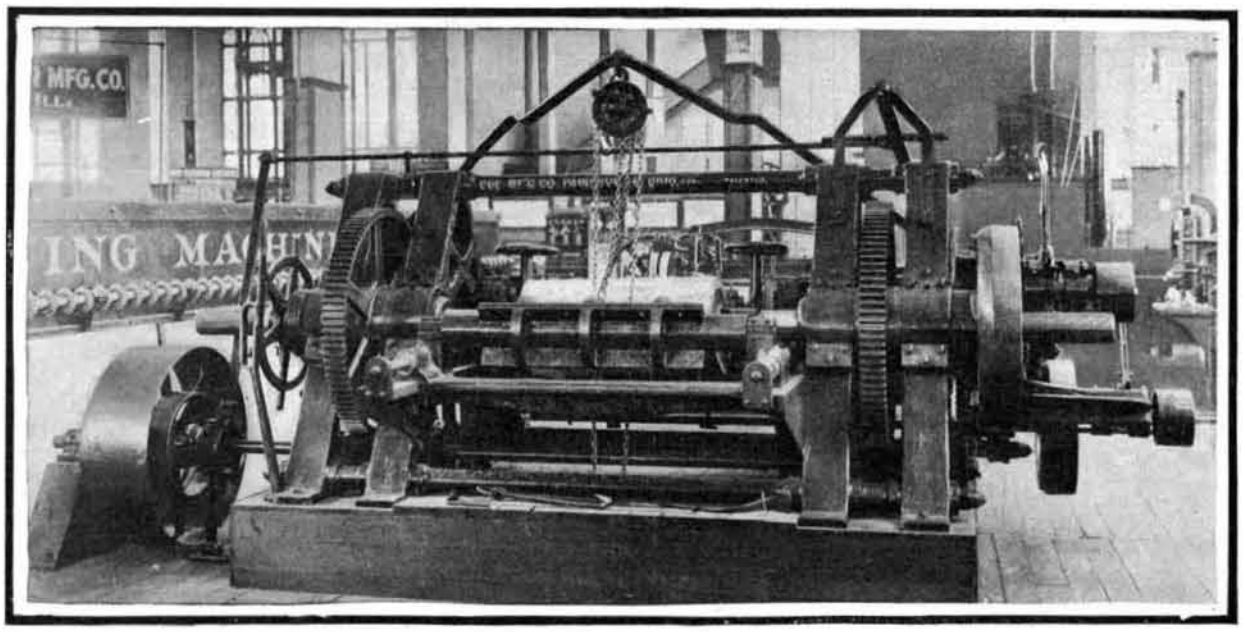
The fine engine built by the Elsaessische Maschinenbau A.-G. and the 700-kilowatt generator to which it is direct-connected, built at Belfort by the Société Alsacienne de Constructions, deserve all the favorable comment that they are eliciting. The engine is of 1,000 horse-power. Steam is admitted by transverse piston valves, carried above the cylinders, one at each end. These are operated by eccentrics, one eccentric serving to operate both the steam admission and the exhaust. The alternating, three-phase generator has a capacity of 700 kilowatts, and a voltage of 2,300.

Another exhibit that we illustrate is a Weber suction gas producer. It consists of a two-cylinder, upright 125-horse-power engine, direct-connected to a 75-kilowatt generator. The unit also comprises a producer, a scrubber and a receiver. It is entirely automatic, the feed of fuel being regulated according to the requirements of the producer; and the whole plant running with great regularity.

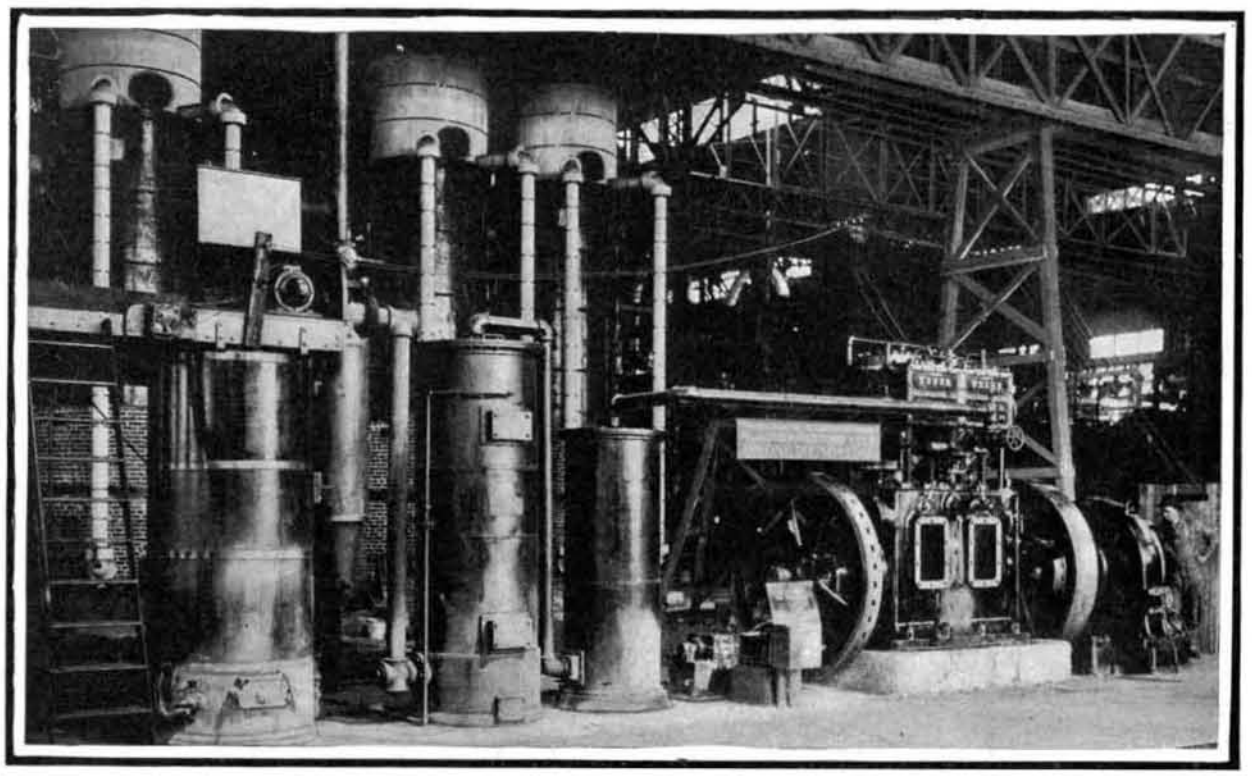
The group of fourteen Worthington fire pumps supplies the whole fire service of the exhibition grounds. The steam cylinders are 18 inches, the water cylinders 10 inches in diameter, and the common stroke is 12 inches. The battery of Cahall watertube boilers is exhibited by the Aultman & Taylor Company, who have contributed sixteen boilers of 400 and 500 horse-power to the boiler house plant. The Willans central-valve, high-speed engine is represented by a 1,000 horse-power unit which is running at 277 revolutions per minute. It is direct-connected to a 600-kilowatt Stanley generator. The engine is of the single-acting type, and runs under a working pressure of 175 pounds to the square inch.

The veneer-cutting machine shown carries the log between centers on which it rotates, and the veneer is cut by a knife held in a horizontal rest—in other words, the veneer sheet is "turned" off the log, and is nothing more nor less than a mammoth shaving several feet in width and length.

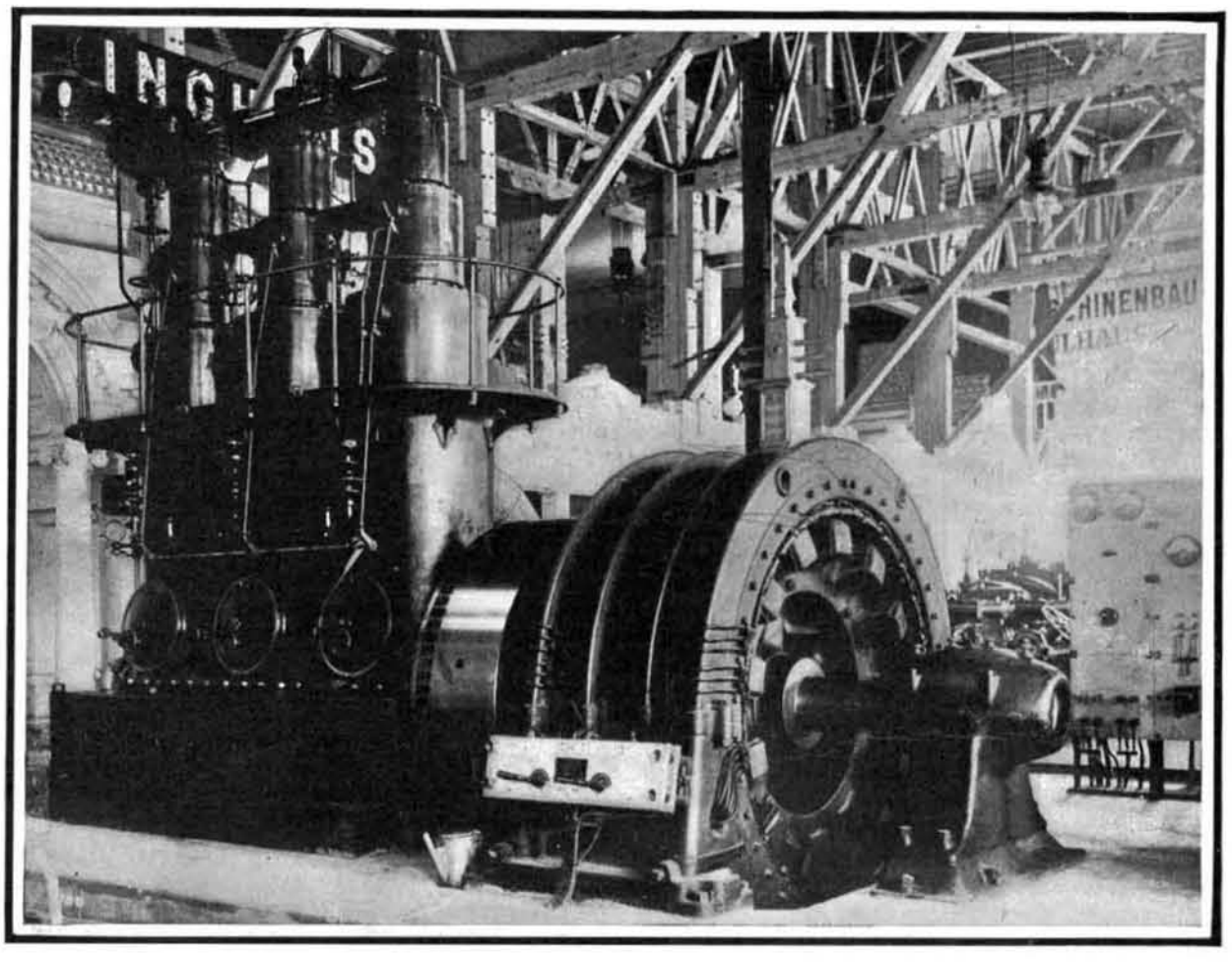
One of the "big" things in the Machinery Building is a huge 20-foot boring and turning mill that weighs no less than 375,000 pounds. The central boring bar and gear are carried on two massive columns. The machine is driven by Bullock motors, that for the main drive being of 80 horse-power and that for elevating the cross-rail of 10 horse-power. The Niles Company do not share the rather prevalent prejudice against any but a positive drive; for this great machine is driven by the friction feed shown in the foreground of the illustration.



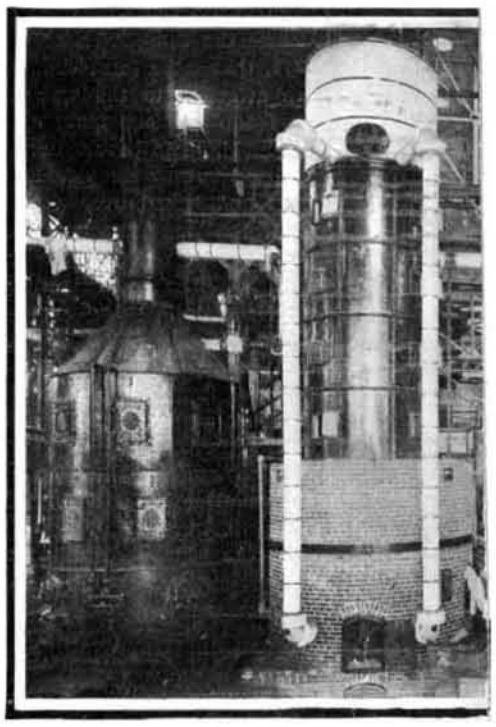
A Veneering Machine in the Machinery Building.



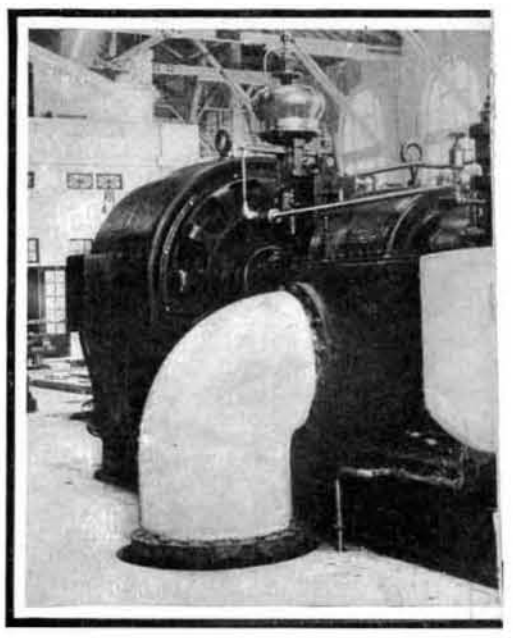
In the Boiler House. Weber Suction Gas Producer and Engine Direct-Connected to 75-K. W. Generator.



A 1,000-H. P. High-Speed Central Valve Engine, Direct-Connected to a 600-K. W. Generator.



Group of Cahall Vertical Watert



Parsons Turbine in the Machinery Building, Con
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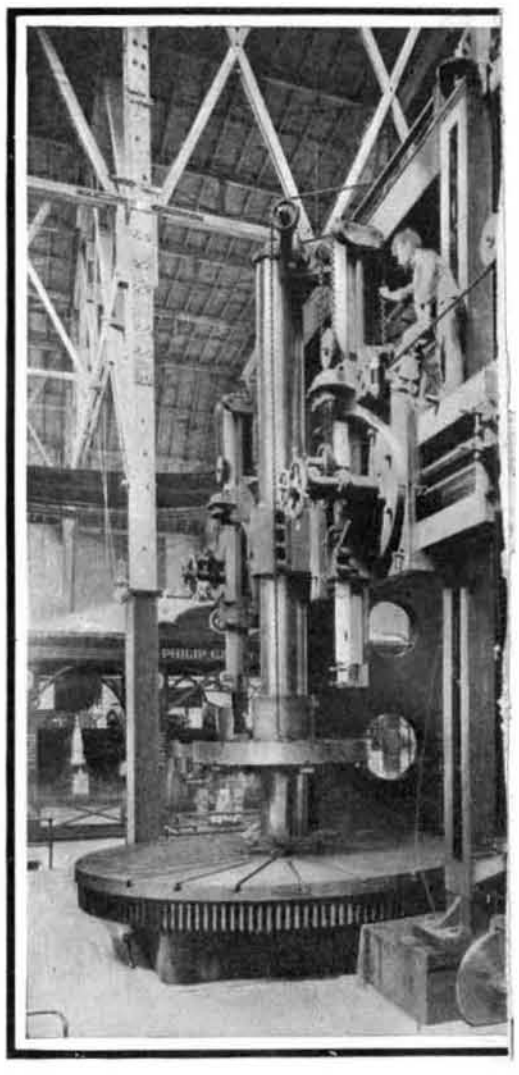

The Largest Tool in the Machinery Building. A
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NOTEWORTHY EXHIBITS IN THE MACHINERY BUILDING AND BOI

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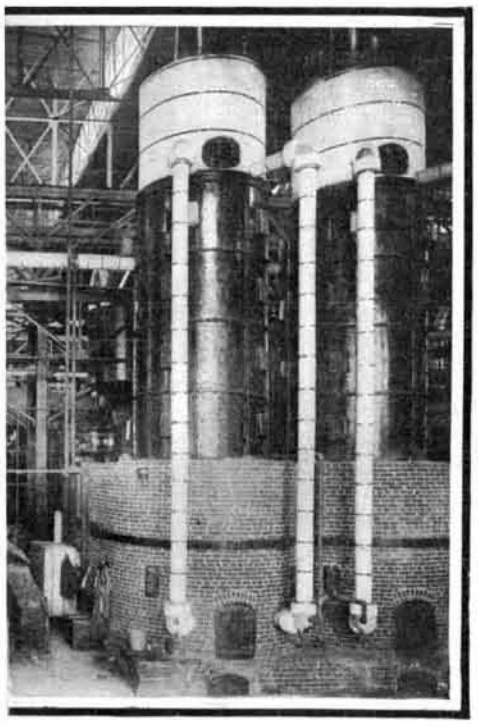
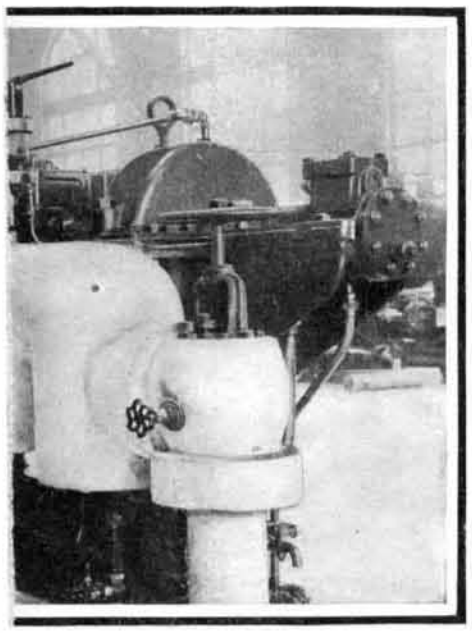


be Boilers in the Boiler House.



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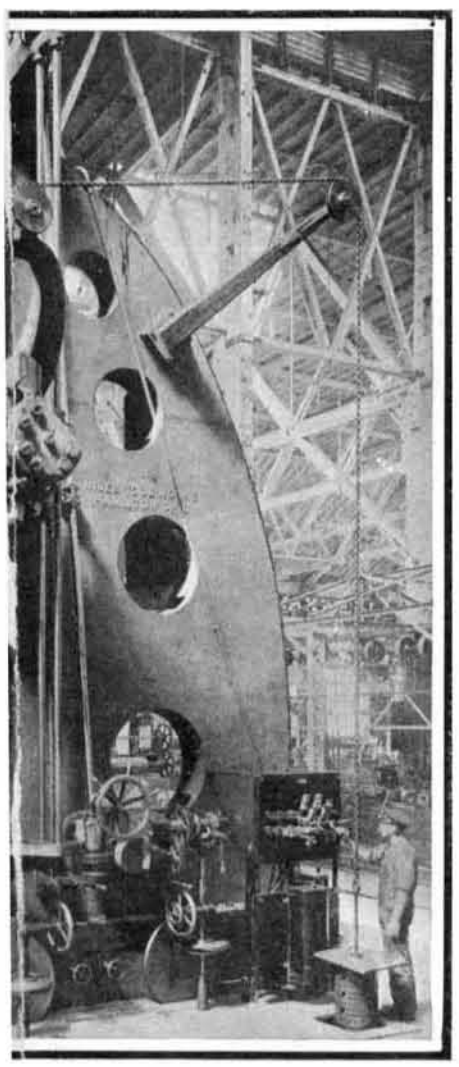

20-Foot Boring and Turning Mill; Weight,
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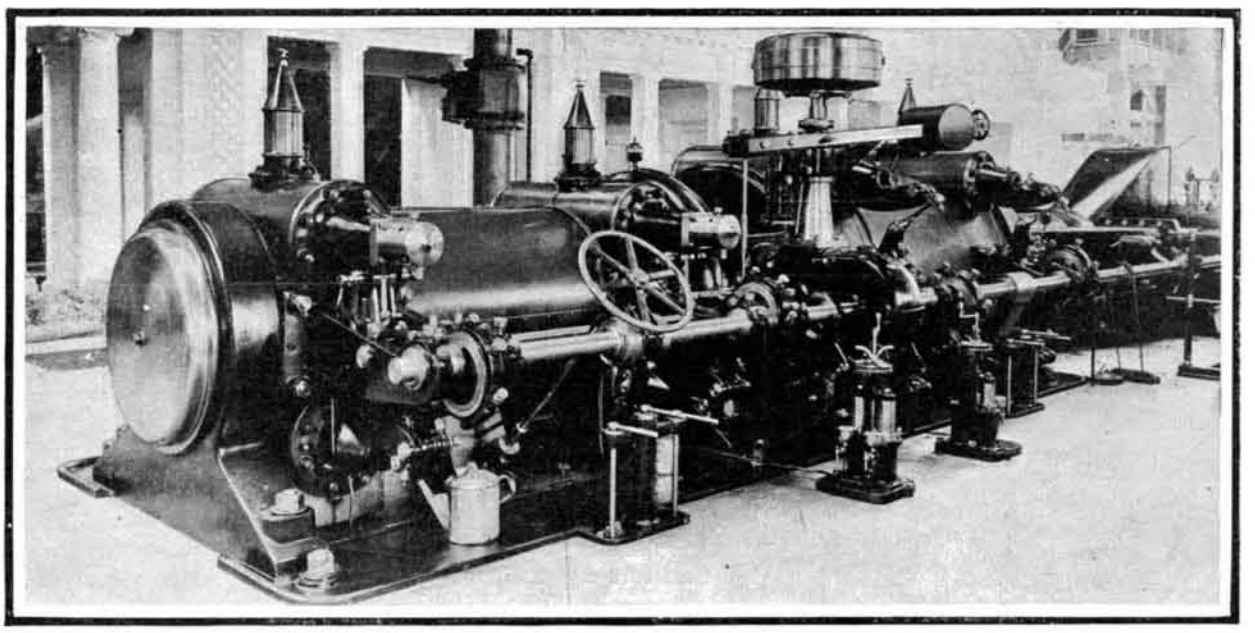
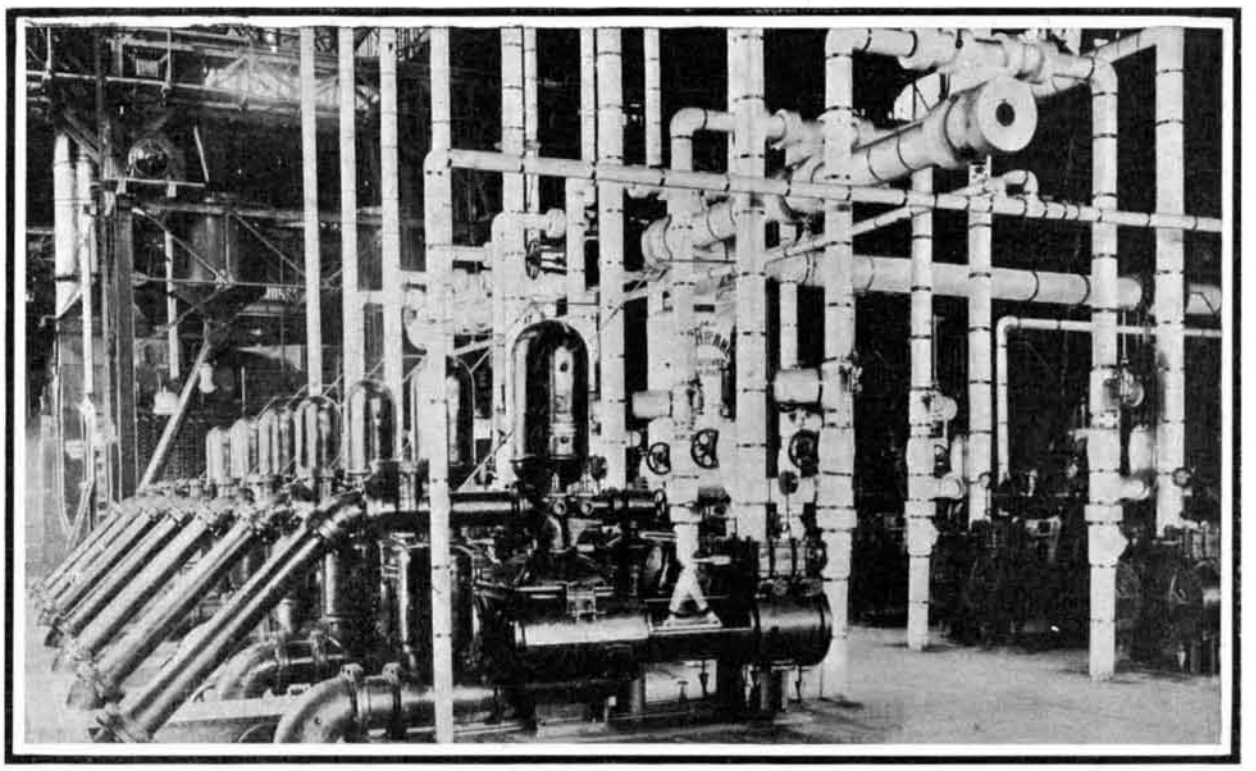
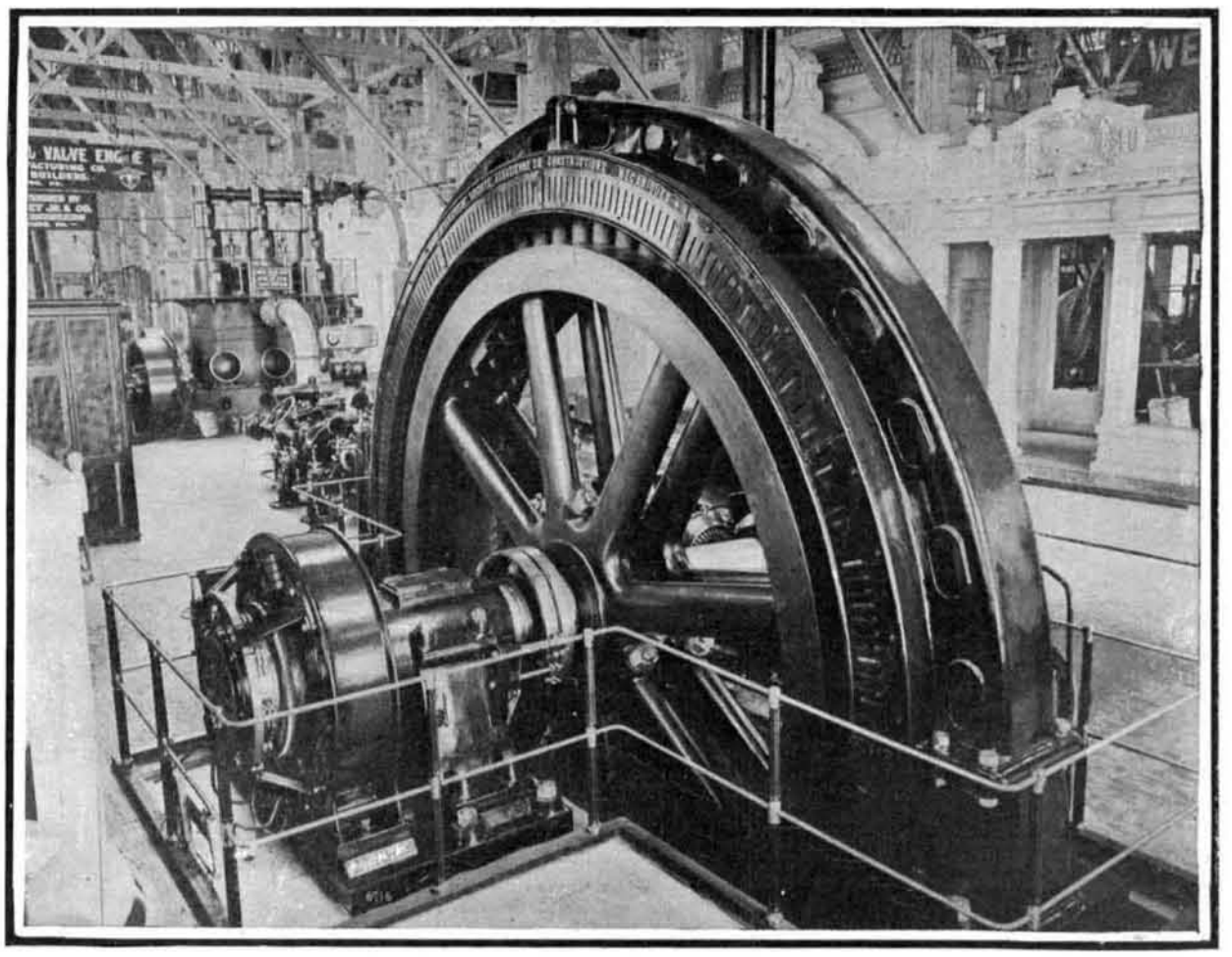


Valve Gear of the 1,000-H. P. Muelhausen Engine in the Machinery Building.



In the Boiler House. A Group of Fourteen Fire Pumps for the Fire Service of the Exposition.



700-K. W. Generator, Built at Belfort, France.

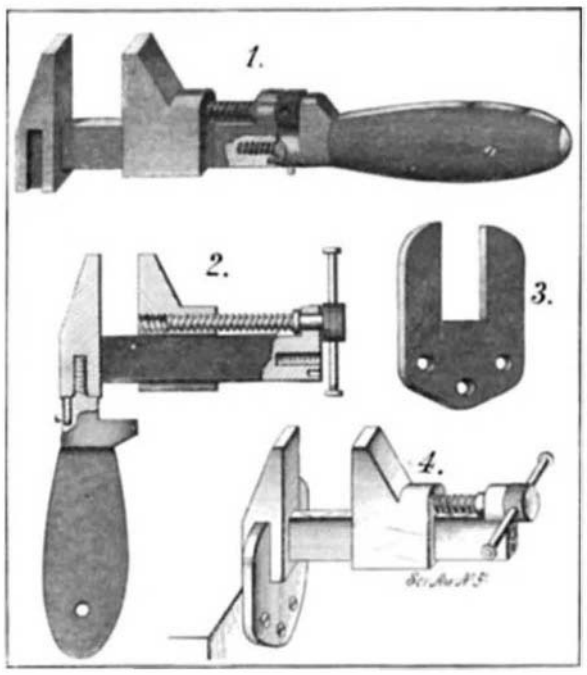
LER HOUSE OF THE LOUISIANA PURCHASE EXPOSITION.

the Scientific American.

Patent Department

CONVERTIBLE WRENCH AND VISE.

Pictured in the accompanying engraving is a very handy tool, which may, at will, be used either as a



CONVERTIBLE WRENCH AND VISE.

wrench or a vise. The wrench is of the usual sliding-jaw type. The handle, however, is detachable, being screwed into the lever bar and normally held by a keeper bolt, as shown in Fig. 1. When it is desired to convert the wrench into a vise, this bolt is drawn back, and the handle unscrewed from the bar and screwed instead into the heels of the fixed jaw of the wrench. The movable jaw is then operated by means of a lever rod, which is passed through an opening in the milled head of the adjusting screw, and, as shown in Fig. 2, the tool is thus converted into a small but powerful hand wrench. As a convenient and preferred means for converting the hand vise into a vise capable of being readily fixed upon a stationary bench or the like for holding work, a bracket plate is provided. As shown in Fig. 3, this plate consists of a flat sheet of metal, having an open slot formed therein and adapted to receive the heel of the fixed jaw of the wrench. The side walls of the slot fit snugly into a pair of channels formed in the fixed jaw, thereby securely holding the device against turning, as indicated in Fig. 4. The bracket is held by screws to the edge of the work bench, and thus the tool is converted into a bench vise. Mr. W. P. Foster, of Jacumba Hot Springs, Campo, Cal., has just procured a patent on this ingenious combination tool.

A PORTABLE PNEUMATIC DUSTER.

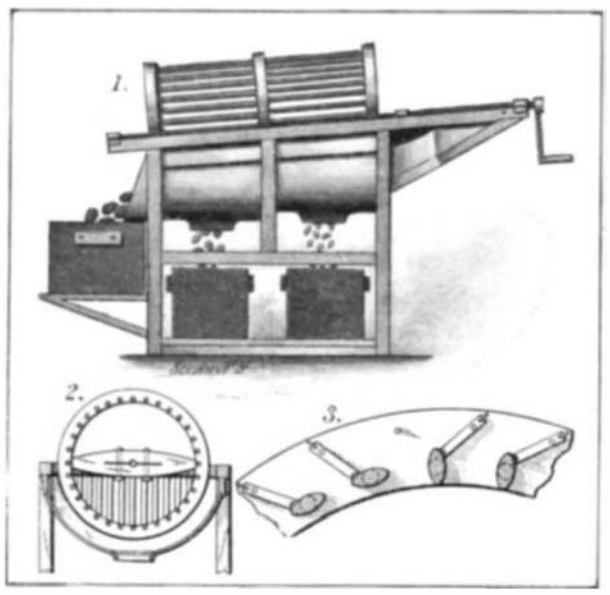
The use of suction apparatus for household cleaning is now so general that it no longer arouses comment. A form of apparatus in which the same principle is involved, has recently been brought out in Paris and will doubtless prove of interest, although the principle is not new. The contrivance in question is a portable

A PNEUMATIC DUSTER.

pneumatic duster, consisting of a bellows constructed somewhat after the fashion of an accordion. From the bellows a tube leads, by which an ordinary duster is carried. Within the bellows packing material is contained which retains the dust gathered. The duster is passed over the object to be cleaned in the ordinary way, and the dust which is displaced is drawn into the tube by operating the bellows. As soon as the dust is caught by the packing material, it cannot be discharged by compressing the bellows. When the packing is quite full of dust, it is taken out and thrown away and new packing is inserted.

FRUIT AND POTATO SORTER.

We illustrate herewith a very simple yet effective machine for sorting fruit or potatoes, which has recently been patented by Messrs. Dana W. Lamb and George Fair, of Pontiac, Mich. The machine comprises a frame in which the sorting cylinder is mounted to rotate. The sorting cylinder consists of two screen sections formed by two series of parallel bars connecting two outer head rings with a common intermediate ring. In the first section of the cylinder these bars are fixed, but in the other section, or the discharge end of the cylinder, the bars are so arranged that they can be adjusted to increase or decrease the screen openings formed between them. This arrangement is indicated in Fig. 3. The bars are oval in cross section, and turn in bearings in the head ring and intermediate ring. Each bar is provided at the outer end with an operating lever, of spring metal, which lies against the face of the head ring. By means of these levers the bars may be turned with the longer axes of the ovals in vertical position, or with these axes in horizontal position, as shown, being held in these two positions by pins on the head ring. It will be evident from Fig. 3 that when the bars are upright the widest possible space is obtained between them.

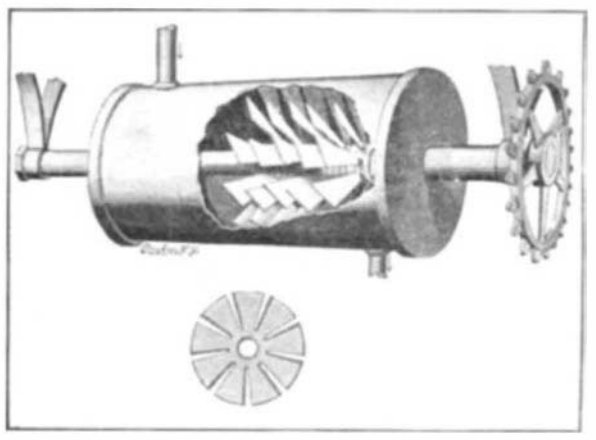


FRUIT AND POTATO SORTER

In operation the potatoes or fruit are fed into the cylinder from a hopper, shown at the right in our drawing, and the screen is rotated by means of a crank on the end of a shaft, which is secured to the intermediate ring of the cylinder, as illustrated in the cross section, Fig. 2. The cylinder is slightly tilted to assist the potatoes in traversing its length. Below each screen section and at the end of the cylinder is a chute leading to a suitable receptacle. The smallest potatoes will fall through the opening in the first section, and the seed potatoes through the second or adjustable section, while the large or marketable potatoes pass out at the end of the cylinder.

DEVICE FOR MUFFLING THE EXHAUST FROM ENGINES.

A patent has recently been granted to Mr. William J. Hewitt, of Del Monte, Cal., for an improved muffler adapted to muffle the exhaust from engines, particularly explosive engines. As shown in the accompanying engraving, the muffler consists of a cylinder within which a series of circulating wheels are mounted to rotate. Each circulating wheel comprises a number of blades inclined like fan blades and arranged in circular series about a hub. A face view of one of these wheels is shown in the engraving. The circulating wheels are suitably spaced apart, on the shaft which carries them by means of collars. The heads of the cylinder are formed with projecting sleeves terminating in brackets which provide suitable support for the muffler. Ball bearings are formed in these brackets for the shaft of the muffler. The shaft is rotated by means of a sprocket wheel at one end. In operation, the exhaust passes into the cylinder through the inlet pipe shown at the left in the engraving. The circulating wheels, it will be observed, are located near the outlet end of the cylinder, and the exhaust is permitted to expand in the space between the inlet and the circulating members, thus losing a portion of its energy. It then impinges against the moving blades, whereby additional force is absorbed, while the revolution of these blades produces a suction which tends to draw out the burned gases from the exhaust valve and considerably decreases the back pressure, thereby increasing the speed of the engine. The exhaust is now discharged through the outlet pipe with hardly audible sound. If it is desired, the circulating members may be so positioned upon the shaft that the space between

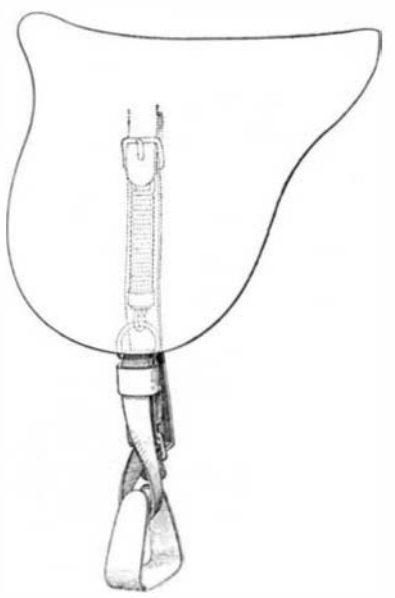


MUFFLER FOR EXPLOSIVE ENGINES.

them gradually increases as they approach the outlet, thus giving the gas a better opportunity to expand.

ODDITIES IN INVENTION.

Saddle.—Pictured in the accompanying engraving is a saddle provided with stirrups so constructed as to ease the jolts of horseback riding. Instead of the stirrup straps usually employed, a spring hanger is substituted, which, as shown by dotted lines, consists of a heavy coil spring, concealed under the side flap of the saddle. In use the rider bears his weight on the straps, and the uneven or sudden movements of the horse are taken up by the springs, which thus cushion the jolts. This renders horseback riding much less fatiguing, particularly to those who are not accustomed to this sport.



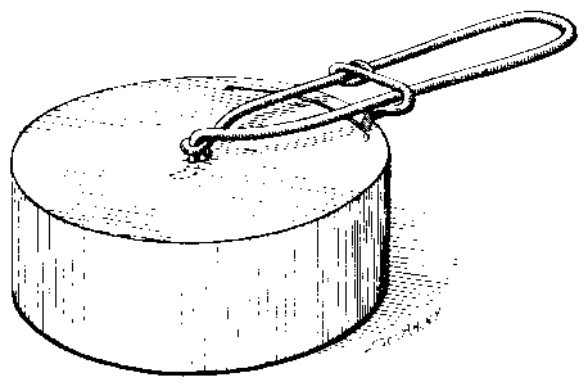
SADDLE WITH SPRING STIRRUP STRAP.

Sulky.—It is difficult to classify the novel vehicle shown in the accompanying engraving. It is in reality a cross between a saddle and a sulky. The seat of the sulky occupies the position of the ordinary saddle, and the feet of the driver are supported in stirrups. But the saddle, instead of resting on the horse, is supported on a yoke frame, that carries a pair of sulky wheels, which run along the ground on either side of the horse. Coil springs are interposed between the posts which carry the wheels and the yoke piece to which the saddle is secured, so as to take up any unevenness in the road. With this type of sulky the driver is afforded all the facilities of a riding jockey in the con-

SULKY.

trol of his horse, while at the same time the horse carries no weight. Sharper turns can be made than if the vehicle were dragged behind the horse and, furthermore, the sulky tends to steady the running of the horse.

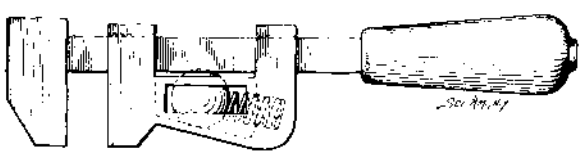
CAN-OPENER.—In the accompanying illustration we show a very simple can-opener which has recently been patented. It consists of a handle formed of heavy wire bent to proper form and terminating in a sharp prong adapted to be driven into the top of the can at



ADJUSTABLE CAN-OPENER.

the center to serve as a pivot or fulcrum on which to turn the can-opener. The cutter comprises a carrier also formed of heavy wire and a projecting prong with sharpened edge and point which constitutes the cutter proper. The carrier is mounted on the handle in such manner that it may be moved to any desired position thereon. The can-opener is thus made adjustable to any size of can. The method of using the device is clearly shown in the illustration.

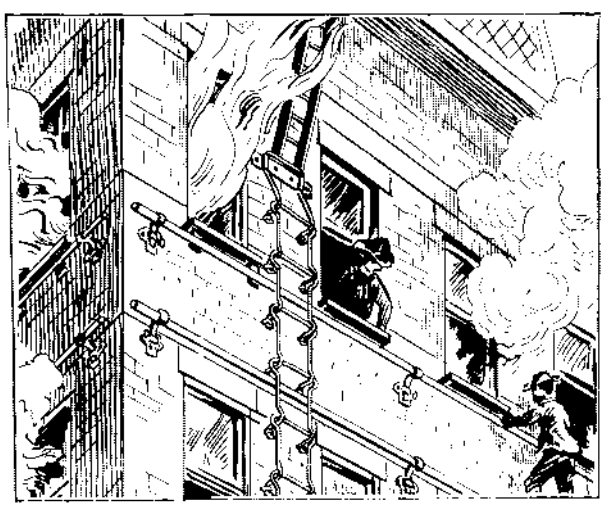
WRENCH.—The wrench shown herewith is adapted to be instantly adjusted to fit any nut merely by the pressure of the hand, in which adjustment it automatically becomes rigidly locked when pressure is applied between the jaws. Instead of the usual rack and worm feed for the movable jaw, the latter is moved by hand to the desired position, and is there held by a steel ball which is carried in a suitable housing in the movable jaw. This ball is pressed by a coil spring between



WRENCH.

the shank of the wrench and the inclined wall of the housing. It will be evident, if pressure be applied to move the jaws apart, the movement will tend to move the ball into the narrower end of the housing, and firmly wedge it between the inclined wall and the shank of the wrench. Thus the greater the pressure between the jaws, the more securely will the movable jaw be locked. When it is desired to move the jaws apart, this can readily be done by seizing the ball between the fingers and drawing it back, when the movable jaw will be unlocked, and can be moved to any desired position.

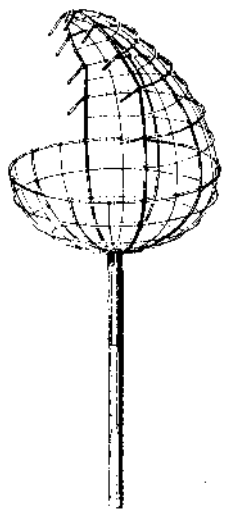
FIRE-ESCAPE.—The fire-escape shown in the accompanying illustration, is made up of a series of intermeshing links, which are individually hooked into eyes set into the side of the building. The advantage of this construction lies in its cheapness and simplicity, and the readiness with which the links may be applied or removed. The links are formed of metal rods bent to a U-shape, or similar to the links of a "ladder," or "square link" chain; but the free ends of each link are bent back to form hooks for engagement with the eye. In setting up a ladder the bottom link is first applied; then the ends of the next link are passed through the first link and hooked on to their respective eyes, and so on, each link serving to hold in place the upper end of the one immediately below it. The upper end of the last link is held in place by a metal



LINK FIRE-ESCAPE.

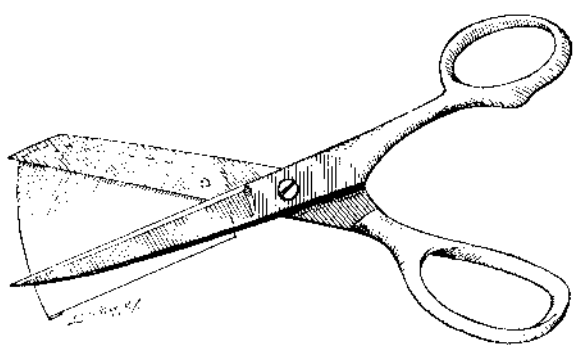
bar, secured to the sides of the building. In order to provide access to the ladder from all parts of the building two parallel rails are mounted between each tier of windows, so that a person walking on the lower rail, and using the upper one as a hand rail, can easily make his way to the ladder. These rails are held in socket pieces attached to the building, and can be readily applied or removed when desired.

FRUIT PICKER.—A simple device for picking fruit, which has recently been invented, is illustrated in the accompanying engraving. It consists of a wire basket formed with an upwardly-projecting hood, which is provided at its upper edge with projecting wire hooks. In use these hooks are slipped over the particular apple, pear, or other fruit desired, and then a slight pull will cause the fruit to drop in the basket. The fall being very short avoids bruising of the fruit. The openwork of the basket prevents dirt from collecting therein and permits the picker to determine when it is full.



FRUIT PICKER.

MAIL SHEARS.—When opening an envelope by cutting off the end with a pair of shears, one is quite apt to clip off an excessive portion, and cut into or injure the contents of the envelope. To prevent this the scissors guard illustrated herewith has been invented. It consists of a piece of sheet metal of approximately triangular shape which is fastened to the upper blade of the shears, and extends downward against the lower blade. An ear formed on the lower corner of the plate prevents the blades from opening too far. In use the end of the envelope is pressed against this guard plate, which serves as a gage to determine the width of the portion cut off. The plate is held in place



MAIL SHEARS.

by screws, so that it may be easily removed when it is desired to use the shears for other purposes.

Brief Notes Concerning Inventions.

A tablet to the memory of Eli Whitney, the inventor of the cotton gin, has been erected at the roadside on the old Whitney estate at Westboro, Mass. The memorial is quite a modest one, but it was placed in such a position that it will be observed by all passers-by.

A machine for skinning tomatoes was recently put into operation at a large canning factory at Woodstown, N. J. Heretofore this work has been done by women, and in the larger establishments it was necessary to employ a great number of them during the tomato canning season, but the operation of the machine is said to be such a great success that it is likely that there will be but little for these girls to do in the future. The machine takes the vegetable directly from the scalding vat and removes the skin from the tomato quickly and effectually.

Public attention has been called in England to a furnace of new design which, it is claimed, will not only prevent smoke but greatly increase the efficiency of the coal used in it. The invention was announced by Sir Joseph Primrose, who is very largely responsible for the invention, at a banquet in Glasgow which was attended by engineers and others interested in matters of this character. The invention consists of burning the coal in a furnace surrounded by a water jacket separated from the boiler so that the gases do not come in contact with the boiler until they have been completely burned. Sir Joseph said that he had declined to say anything about this new boiler until he had been thoroughly satisfied of its efficiency in every way by actual tests. The matter was made the subject of a report by Consul-General Richard Guenther, at Frankfort, Germany.

An entirely new thing in the manufacture of pocket knives comes from Germany, the firm of J. A. Henchels, Solingen, being responsible for it. In these knives, the handles are sawed from one solid piece of ivory, pearl, or tortoise shell. There are no bolsters, and as the lining and back are in one piece the different parts consist merely of the blades, springs, rivets, and handles. In this construction all the blades are necessarily on one side. The one of ivory, for instance, is ⅝ inch wide and 9-32 inch thick. It has four blades, and the two pairs are separated from each other by a partition of ivory. Because of the impossibility of obtaining pearl and tortoise shell of sufficient thickness, these materials are made up into small two-bladed knives only. These knives have an exceedingly neat appearance, the absence of metal being very noticeable.

In a recent report made by Consul-General Guenther at Frankfort, Germany, he calls attention to a new metal which seems to be possessed of a number of virtues, the invention of a French engineer, Albert Nodon, and who has called the new material "nodium," after his own name. It is lighter than aluminium, has the color, luster, and structure of steel, has the malleability of bronze and has a conductibility for the electric current equal to that of copper of the same weight. It is suitable for being cast into forms, and the inventor hopes that it will be found available not only for electric wires and cables, but also for parts of mechanical construction of various kinds where strength is required and where it is desirable to have the parts as light as possible. No information is given about the composition of the new metal, but it is said to be made by an electrical process at a cost of about 15 cents per pound.

Marcus T. Hitchcock, the inventor of a car-ventilating system which has been in almost general use for the last thirty-five years, died at his home on Boylston Street, Boston, Mass., November 23, 1903. He was 86 years of age, and had not been actively engaged in business for some years, but his health had been good until a few days prior to his death. His father was one of the "minute men" of the revolution, and resided at Springfield, Mass., where Marcus Hitchcock was born and reared. His inventive genius cropped out early in his youth, when he was employed at a milling machine in the Springfield arsenal. The machine not suiting his purpose, he improved it, and the improvement was soon adopted and a number of other machines built according to his suggestion. He afterward became master car inspector for one of the railroads of the New England States, and while working in this capacity he designed the ventilator bearing his name. He was also the inventor of a smoke-burning device, an apple dryer, and a number of similar things.

Leonard Henkle, the man who originated the Rochester lamp, which is now in use all over the world, died almost in poverty at Rochester, N. Y. He was also the inventor of features of other lamps, but none attracted so much attention as the Rochester. He was born on May 15, 1834, and much of his time is said to have been spent in fostering various schemes, most of which had for their objects the uplifting of his fellow man. Many of these were visionary and but few of them received any support from those whose interest he endeavored to enlist, because of the absence of pecuniary rewards. In many respects Mr. Henkle was far ahead of his time, and he is said to have been the first person to suggest the idea of a great power plant driven by the Falls of Niagara. He spent considerable time in traveling among the cities of New York in the vicinity of the Falls and endeavoring to get them enlisted in a great industrial movement having for its object the utilization of the Falls, but this was considered far from practical at the time, and he was laughed at for his trouble. The old man lived to see the greatest power plant in the world in operation at this point, but the project was brought about on lines very different from those suggested by him.

The latest development of the car-fare register consists of a device which makes a printed and detailed record of the business of each trip made by the car and gives the totals for the day. This report is made on a sheet which can be filed away for future reference and the value of such a record is apparent to anyone acquainted with the street railway business. Such a report, it is said by the inventor, will do away with the possibility of disputes between conductors and railway officials involving the business done. It not only makes a visual record of every fare as it is paid, just as do the registers at present in use, but also makes the permanent record of such matters as the number of full fares, number of half fares, and the tickets of various kinds; also the number of the conductor who may have been in charge of the car on each particular trip, and finally, the number of the inspector or other official whose business it may have been to take the printed sheet from the machine. The record of the conductor is secured by making the machine inactive until an individual key supplied to the conductor has been inserted in its proper place. The conductor must do this when he takes charge of the car, withdrawing the key when he leaves it. In order to unlock the machine the succeeding conductor must make use of his own key, and thus the change of responsibility will be made apparent. This machine is the invention of Will I. Ohmer, of Dayton, Ohio.

RECENTLY PATENTED INVENTIONS.

Apparatus for Special Purposes.

CONDENSER.—O. S. STILL, Annette, Cal. The invention relates to a condenser especially intended for use with an apparatus for extracting mercury from cinnabar and analogous ores. In operation the vapors generated in a furnace retort are led into the upper part of the condenser shell where they are met by a spray. The vapors are thereby condensed and the condensate falls to the bottom of the shell. A body of water in the bottom of the condenser prevents the falling quicksilver from striking the bottom of the condenser and becoming divided into small particles, which would tend to return it to a vaporous state.

Dental Appliances.

DENTISTRY.—D. T. HILL, Syracuse, Neb. The invention provides a simple means for securing artificial molars and bicuspids in position in such manner that the denture cannot be accidentally displaced, but may be readily removed when desired. The locking device comprises a box-like member provided with a V-shaped spring. This attaches to the rubber plate on which the artificial teeth are secured and the locking device itself is secured to a crown which engages over a natural tooth.

DENTAL APPLIANCE.—F. C. ROOD, Walla Walla, Wash. Dr. Rood's invention relates particularly to devices for trimming the roots of teeth in preparing them for crowning with Richmond, Logan, or other dowel or pin crowns. The arrangement is such that the pin which enters the root canal is connected movably with a cutter, so that the cutter can be turned at different angles without displacing the pin from the root canal and without necessitating any unnecessary enlargement of this canal.

Electrical Devices.

INTERCHANGEABLE TELEGRAPHIC KEY.—W. C. DEAN, Quitman, Ga. This invention is an improvement upon that form of interchangeable telegraphic key or combined key and switch in which a single key is so constructed and arranged as to be used in common with any number of telegraphic circuits and instruments, doing away with the necessity of the operator changing his position from one instrument to another, and also of carrying a typewriter from instrument to instrument when messages are to be transcribed thereon.

Of Interest to Farmers.

KNOTTER-GEARING.—J. M. RECTOR and W. H. ROSBURY, Monarch, Mont. The object of the invention is to dispense with toothed gearing ordinarily employed for connecting the driving shaft with the knotter shaft, and to provide a superior means for transmitting the movement through the medium of crank arms and a link connecting them.

Of General Interest.

CHEESE-GAGE.—W. H. FRANK, Burkesville, Ky. The invention is an improvement in that class of cheese gages which are adapted for use in cutting up cheese into slices of a desired weight, size, or price. The present invention is an improvement upon one previously patented by Mr. Frank, and is arranged to hold and guide the cheese in an improved manner, so that the slices severed will have uniform faces instead of being cut at greater or less angles, as might otherwise be the case.

COLLAR.—A. JOHNSON, Wellsville, Ohio. The invention is an improvement in dog collars. The collar is so arranged that it will be contracted when the dog pulls on the chain, thus exerting a pressure to restrain the dog. It will be found especially useful with dogs that slip the collar, as the device is self-adjusting, and the weight of the dog chain will regulate its size. The dog, therefore, will not be able to get the collar off, as the harder he pulls, the smaller the collar will become.

COMPOSITION OF MATTER.—E. C. MAY, Chicago, Ill. The object of the invention is to provide an improved composition of matter for the manufacture of firebricks, tiling, etc., and which is exceedingly hard and solid, and not liable to deteriorate under the influence of air or high heat. The composition of matter consists of the following ingredients: Pulverized coal ashes, 1 ton; powdered silica, 1-5 ton; and a binding material, such as cement, or lime, 1-5 ton.

GOODS-EXHIBITOR.—P. J. KOLL and J. J. KOLL, Earling, Iowa. This apparatus is designed and adapted by these inventors for use by merchants for suspending and displaying robes, rugs, and the like. The chief objects aimed at in its construction are simplicity, cheapness, strength, portability, and adaptation for exhibition of a series of robes or rugs to the best advantage and in minimum space.

CALCULATING APPARATUS.—A. B. BLY, Ottumwa, Iowa. The invention relates to apparatus for performing various mathematical operations, being particularly adapted for the addition of serials of numbers. Its principal objects are to provide a simple yet accurate apparatus. Any combination of numerals, the sum of which does not exceed the capacity of the apparatus or is less than thousand millions, may be added. The same general method is employed in subtraction, except that for the number to be deducted belts are moved in opposite direction. Multiplications may be treated as multiple additions and division as multiple subtraction.

BOOK-FINISHER'S STAND.—V. KLING, Council Bluffs, Iowa. In finishing books on the back it is the usual practice to place the book in a clamp to hold it firmly; but as the book must be turned many times in order to do the work on either side of the "hubs" it is necessary to open the clamp and manually turn the book and again place it in the clamp. To obviate this work is the aim of the inventor, by means of which a book may be readily turned without taking it out of the clamp until the book is entirely finished.

DUST-COLLECTOR.—R. L. HOLLINGSWORTH, Faith, Ga. Though adapted for use in other places the inventor's improvements are intended more especially for use in factories, mills, and the like for collecting from the air therein any and all dust, shavings, or other solid particles with which such air may be laden; and one of his principal objects is to provide a device simple in construction, comparatively inexpensive to manufacture and thoroughly effective and reliable in operation.

BRACKET.—J. F. KRESS, W. LOSHELDER, H. O. GROSS and H. LOSHELDER, Jr., Pittsburg, Pa. While this bracket is simple and inexpensive to construct, it serves to support both the shade and drapery for windows of any width and for the application of various lengths of shade-rolls and drapery-poles after the brackets have been fixed in place, thus providing without change in position for the curtains of different users and for variations in the position of draperies in accordance with different tastes.

GARMENT.—I. L. MARROW, New York, N. Y. It is customary to provide garments, especially such as men's and boy's drawers, with non-elastic loops of tape at or near the top, through which may be passed suspender-ends or other supporting attachments for holding the garments in the proper position. As these and the material of which the garments are made do not stretch, the loops are frequently of no service, especially for tall men, and when the waists of the garments are short. Mr. Marrow's main object is to overcome these objections.

CALENDAR FOR PENCILS, ETC.—F. SPILLANE, New York, N. Y. In this instance, the object is to provide a calendar for pencils, penholders, and like articles arranged to permit the user of such articles to have ready reference at any time to the calendar for obtaining a desired date of the present month, the calendar being very simple in construction and easily applied to the article.

BOOK-CLAMP.—J. N. BOSTICK, Fresno, Cal. More definitely stated, this invention relates to novel means whereby loose leaves may be held and bound into book form by stapling or other securing means. Specifically stated, the invention consists of a peculiar spring-acting clamp adapted to be secured upon the top of a table or other support and means for working it.

FOUNDATION-ANCHOR FOR BRIDGES.—P. P. CARVER, Estill Springs, Tenn. In this patent it is the object of the invention to provide an improved means for fastening hollow bridge columns or pipes used for other purposes in stone or rock foundations. To this end Mr. Carver has adopted and successfully employed the means. The invention is applicable in cases where no water exists.

Hardware.

WRENCH.—R. J. COSSEBOOM, Leadville, Colo. Mr. Cosseboom's invention relates to improvements in pipe-wrenches of general type, the object being to provide a wrench of this character that will be simple in construction, having no parts liable to get out of order, and that may be readily adjusted to a pipe or rod and rigidly grip the same without danger of marring or crushing it.

SAW.—G. G. MCGILL, Decatur, Ind. The principal object of this invention is to make a saw that will cut through flooring, weatherboard, timber, and the like, at all places where a section of board is to be removed without first boring holes and using a Keyhole saw to start the kerf. The blade of the saw is curved at the tip and provided with teeth both on the lower and the upper edge.

DOOR OR WINDOW LOCK.—W. F. MARTIN, New York, N. Y. The purpose of this invention is to provide an absolutely secure lock by which to fasten doors, windows, and the like against entry from one side, the purpose being in practice to place the lock on the inside of the door or window, so as to lock the same against opening from the outside.

WRENCH.—C. H. RITTS, Wausa, Neb. In this case the invention relates to improvements in wrenches, particularly adapted for tightening screw-threaded calks in horseshoes, but obviously adapted for tightening nuts, lag-screws, and the like; and the object is to provide a wrench of this character that will be very simple in construction and adapted to operate with comparatively little manual exertion.

Heating and Lighting.

WATER-HEATING APPARATUS.—A. P. BROOMELL, York, Pa. In this patent the invention is an improvement in water-heating apparatus commonly called "fuel economizers," and has for an object to provide a novel construction whereby to prevent the splitting of the headers from the pressure exerted in forcing the tubes or pipes into such headers.

HOT-WATER HEATER.—J. A. COPPRIDGE, Roanoke, Va. This hot-water heater comprises a firebox formed of four corner standpipes connected by horizontal pipes and leading to a hollow crown sheet or dome. The whole is encased in a metal or brick casing. The dome is formed with depending chambers for heating the water to a high degree before it passes out to the radiators. The firebox is provided with an improved type of door.

Machines and Mechanical Devices.

LEAD GAGE AND ARBOR LEVEL.—M. C. BARRY, Atlanta, Ga. The device is adapted for setting a carriage and arbor of a circular sawmill so that the saw will cut directly parallel to the carriage. By means of this device, the crude and clumsy method of using a long string or cord for gaging the carriage is obviated. The device can be gaged within a few minutes by an unskilled person in lining up a mill and getting the desired lead.

NUT-HOLDER.—G. F. ZWILLING and C. W. RICHARDS, Cleveland, Ohio. This nut-holder is designed especially for automatic nut-tapping machines. The device is arranged to provide for holding the nut with that firmness necessary to the operation of the tap therein, and yet allowing the nut a certain bodily movement transversely of the tap, so that should the sides of the nut not be true, it may be shifted laterally as the tap enters the nut, and the tap allowed to operate evenly.

CAMERA.—L. NESEMANN, New York, N. Y. The purpose of the invention is to provide an effective form of camera in which accommodation is afforded for a large reel of films, and means for conducting the films past the rear of the camera box in such manner that "moving pictures" may be taken or so that individual pictures may be taken at will. An alarm is provided which will be sounded after a predetermined number of pictures have been taken.

AMUSEMENT APPARATUS.—C. V. JOHNSON, Salt Lake City, Utah. In this apparatus a rolling object, such as a bicycle, under the control of a rider, travels about a vertical looped path, by virtue of centrifngal force generated and under the momentum acquired from its passage down an incline leading to the loop. It is more particularly applicable to apparatus in which a portion of the path is omitted to cause the rider to leap across the gap thus formed under the impetus he has attained.

WORK-CARRIER.—G. A. ENSIGN, Defiance, Ohio. The invention relates to woodworking machines, such as mortising machines, boring machines, and the like. The workcarrier is arranged to have a limited sliding motion between adjustable stops, or a free unlimited sliding motion for any desired distance independent of the stops.

AUTOMATIC DOOR-ALARM.—P. BOURNE, New York, N. Y. One purpose of this improvement is the provision of an alarm attachment for doors brought into operation by the slightest turn of a door-knob with which the device is connected and which device may be expeditiously carried from and locked out of action whenever desired.

MOVABLE MAP AND MACHINE FOR OPERATING SAME.—T. IKEMORI, New York, N. Y. The purpose here is to provide a machine having means whereby maps may be moved relatively to each other simultaneously or in any sequence, and whereby any one map may be independently and singly moved with panoramic effect to demonstrate a route traveled over by a party, and to illustrate geographic features traversed and line of travel, as from town to town, country to country, etc., and to provide means for illuminating portions of maps and displaying at intervals illuminated scenes in travel of the person and forming the subject of the display or lecture.

TYPE-EJECTING DEVICE IN TYPE-CASTING MACHINES.—J. MAYER and C. ALBRECHT, Berlin, Germany. This invention relates to a device of the kind described in the inventor's other application for United States patent. The type-mold there described is adapted for producing a plurality of types at a time. It is provided with a plurality of parallel cross-cavities in a plane, and consequently the type-ejecting device comprises a comb-like ejector, the teeth of which are either made in one piece with a part of the machine or secured thereon by suitable known means. In the latter case the construction is such that distance between the several teeth can be varied to the circumstances.

CLAMP FOR HAT-PRESSING MACHINES.—V. J. LAWSON, New York, N. Y. In this patent the invention has reference particularly to a new and improved clamp intended for use in connection with hat-pressing machines, by means of which the felt may be drawn outward from the mold in case the felt does not reach to the edges thereof.

JACK FOR MINING-MACHINES.—M. RAINES, Decota, W. Va. This improvement is especially adapted to that form of mining-machines in which a drill is used and which have to be braced between the roof and the floor of a vein in order to secure the proper pressure for operation. It is applicable, however, to various forms of mining-machines and not limited to the mining of any particular material, although the inventor desires it specially to apply to the mining of coal.

REVERSING MECHANISM.—F. C. MUDD, Ellisgrove, Ill. The invention relates to eccentrics reversibly mounted on their shafts; and its object is to provide reversing mechanism more especially designed for use on locomotive-engines and other engines and machines and arranged to allow convenient reversal of the eccentric at the will of the operator and protect the working parts against dust, etc., to insure a proper working of device at all times.

MACHINE FOR CALCULATING INTEREST AND PERCENTAGE.—W. M. BRALY, Blackwell, Oklahoma Ter. The purpose of this invention is to provide a machine for calculating interest and percentage which will be of simple and economical construction, concise, accurate, and readily operated. The machine accomplishes this, in such transactions, as, when the rate of interest and time are given to find the interest: when the interest and rate are given to find the time, etc., in an improved and satisfactory manner.

Prime Movers and Their Accessories.

BOILER STAY-BOLT.—J. PETERS and J. COLEMAN, El Paso, Texas. This improvement is in the nature of a novel form of steam-boiler stay-bolt, designed to connect the crown-sheet of the firebox with the outside shell of the boiler, and it consists in such construction of bolt and the combination of the same with the sheet and shell as will secure a strong connection of these parts, which will compensate for expansion and be capable of adjustment, and which will also facilitate the making of repairs and the tightening up of the bolts against leakage.

Railways and Their Accessories.

THIRD-RAIL COVERING.—T. BUCKLEY, New York, N. Y. The invention relates to means for shielding the rail from the action of the weather, and also to the protection of life and property against the dangers of the rail when energized. A wall is located on each side of the rail and two arched metal coverings protect it above. These coverings are normally held in engagement with each other by coiled springs but are adapted to be spread apart by pilot-shoes to admit the contact-shoe of the car.

CAR-WHEEL AND AXLE.—W. A. HONEYMAN, Wallace, Idaho. In carrying out the present invention the object particularly in view is the provision of an improvement which will be exceedingly simple in its construction and which will be durable—that is, able to stand the hard uses incident to conditions under which it is employed. The inventor provides an axle which is self-oiling; and means for locking the wheels in position on the axle, the construction being such that a minimum of friction is had with the maximum strength and security.

EMERGENCY-COUPLING.—G. J. HUBBARD, Port Jervis, N. Y. In this patent the invention refers to railroad car-couplers; and its object is to provide a coupling arranged to permit of conveniently tying or coupling the draw-heads of adjacent cars together in case the coupling mechanism of the draw-heads is broken or out of order.

Pertaining to Vehicles.

STEERING DEVICE.—W. H. DOUGLAS, Belleville, N. J. The inventor's object is to provide a device which can only be actuated from the steering-wheel, and when not required for steering needs no attention or holding on the part of the operator, as it is locked in any position in which it is left and is not affected by jars or strains when the conveyance travels over rough roads, for instance, the device requiring but little power to actuate when it is desired to steer the conveyance. It relates to automobiles and similar road-vehicles, aerial and marine vessels, and other mechanial conveyances requiring steering.

Designs.

DESIGN FOR A FOLDING-CHAIR.—H. C. STROBEL, New York, N. Y. This design is of an ornamental chair shown in perspective. It is extremely delicate and artistic in its curved and straight lines and finely proportioned. A dotted four-pointed star with a ring in its center, in which a round spot is placed, occupies the middle of the chair seat.

BADGE.—C. L. JENNINGS, Leander, Tex. This is a design for an article or device intended for use on goods, chattels or other property to indicate that they are for sale. The device is in the nature of a badge which may be attached to the clothing or property of a person, or otherwise employed for the purpose above stated. The article is a block or disk having its face ornamented by figures in different colors which readily attract attention.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Marme Iron Works. Chicago. Catalogue free.

Inquiry No. 6063.—For manufacturers of salt driers.

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 6064.—For manufacturers of rain-makers supplies, canvas, explosives, etc.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 6065.—For a computing device consisting of two or more dials, operated with a stylus or like article, to be used in multiplication and division only.

For bridge erecting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 6066.—For parties to manufacture men's collars to order, also for makers of machines for securing metal tips to shoe strings.

Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 6067.—For parties to do drop press work on wire steel.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 6068.—For makers of Newhall and Julius Smith's electric firing batteries.

If it is a paper tube we can supply it. Textile Tube Company, Fall River, Mass.

Inquiry No. 6069.—For makers of machines and supplies for tattooing.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 6070.—For manufacturers of hollow glass novelties.

D. A. Beaton, Practical Lead Burner, P. O. Box 334 Woburn, Mass. Fifteen years' experience.

Inquiry No. 6071.—For manufacturers of pin-pointed wires.

Special Machinery to order, manufacturing, metal stampings, etc., Brickner Machine Co., Tiffin, Ohio.

Inquiry No. 6072.—For makers of solder for soldering aluminum.

American inventions negotiated in Europe. Wenzel & Hamburger, Equitable Building, Berlin, Germany.

Inquiry No. 6073.—For machinery for extracting oils from oranges and lemons, and for parties engaged in the same.

Patented inventions of brass, bronze, composition or aluminum construction placed on market. Write to American Brass Foundry Co., Hyde Park, Mass.

Inquiry No. 6074.—For apparatus for burning wood into charcoal.

FOR SALE.—Valuable patent, 666,159. Specifications and drawings sent on request. H. O. Robinson, 445 Saratoga Street, East Boston, Mass.

Inquiry No. 6075.—For a very light-draft, stem wheel gasoline boat 25 to 35 feet length.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company Foot of East 138th Street, New York.

Inquiry No. 6076.—For makers of small Ferris wheels.

DRY BATTERIES.—How to make and use them. Practical, with original drawings. Mailed for 25 cents. Spon & Chamberlain, 123 S Liberty Street. New York.

Inquiry No. 6077.—For manufacturers of napping machines.

Sheet metal, any kind, cut, formed any shape. Die making, wire forming, embossing, lettering, stamping, punching. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 6078.—For a railroad lantern which burns acetylene gas.

WANTED.—Hardware novelties and other articles of merit. Must be good sellers. Will buy outright or sell on royalty basis. The Cleveland Sales Company, 407 Arcade, Cleveland, Ohio.

Inquiry No. 6079.—For a thermometer which will register 500 deg. or 600 deg. below zero Fah.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 6080.—For makers of worms for corkscrews.

Two patents for sale. Supply tanks for water service, No. 769,550. Valve, a cut-off, for supply tanks, No. 737,941. Can furnish some valves, cut-off, in working order. P. J. Leithauser, Clarendon, Texas.

Important Patent For Sale.—The only perfect horn for talking machines. Patent No. 771,441 is a basic patent absolutely necessary to manufacturers of talking machines. Address Horns, Box 773, New York.

WANTED.—First-class man for engineering department. One familiar with shop practice and designing, and able to draw up ideas. State age, experience and salary expected. Address The Ohio Brass Co., Mansfield, Ohio.

FOR SALE.—Canadian patent No. 83,867, dated Nov. 10, 1903. Covering vital points in telephone development. Important subsequent improvements free to purchaser. Address Dennis O'Brien, Limestone, New York.

Winona, Minnesota.—Population, 24,000—Wants Manufacturing Plants. For particulars address Geo. W. Gregory, Secretary of Board of Trade.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

FOR SALE.—U. S. patent No. 767,866, patented August 16, 1904. Variable speed and reversing gear can be applied directly to any machine, motor carriage and launches. Address John C. Busche, 17 Brown Ave., Turtle Creek, Pa.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C.A. M., Box 773, New York.

WANTED.—A first-class, all-around mechanic, tool maker and tool designer, preferably between 35 and 45 years of age, with considerable executive ability in handling men; one having had considerable experience in the designing and building of special tools, jigs and fixtures, such as are used on fine special machinery requiring accuracy and duplication of parts. A man capable of bringing tools and machinery up to the highest possible point of efficiency. A first-class position, and one of rapidly growing responsibility to the right man. Address, giving age, experience in full, stating positions held in past, references, and salary desired, to Ability, Box 773, New York.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9465) S. A. C. asks: Will you please tell me why the problem of squaring the circle is said to be impossible? I know that the ratio of circumference to diameter, which enters into the problem, is an incommensurable ratio, but how can anyone say that a method can never be found for drawing two lines in that ratio? We have many lines which are related to each other by incommensurable ratios, and I fail to see why that particular ratio should be impossible. I am always laughed at when I say I am trying to square the circle. A. The problem of squaring the circle requires the finding of the side of a square whose area shall be equal to that of the given circle. No such square can be found. The area of a circle is πr^2, as is proved in geometry. The numerical value of π is 3.141592, etc. It has been calculated to 250 places of decimals, and will never end. That means that it has no exact value. Any desired degree of approximation may be used, but in the end there is only an approximation, and not a definite, accurate result. Since π has not an exact numerical value, πr^2 has not an exact numerical value. No circle can have its area expressed in a whole number if its radius, or diameter, or circumference is expressed in a whole number; and on the other hand, if the area of a circle were a whole number, the radius, diameter, or circumference could not be a whole number. Now, if the area of a circle is not a whole number, the square root of that area, which is the side of the square of the same area, will not be a whole number, nor will the square root ever terminate, however far it is carried out. Thus you will see that the side of a square of the same area as any given circle cannot be found. All such constructions as you inclose are more or less close approximations, useful in mechanical drawing, but of no value in exact mathematical work. The squaring of the circle is known to every mathematician to be impossible. In application of this, take 1 inch as the radius of a circle; the area is 3.1416 square inches nearly. The side of the equivalent square is 1.7668 inches. This is close enough for ordinary purposes, but is not mathematically exact and never can be calculated to exactness. This is what is meant when it is said that the squaring of a circle is impossible.

(9466) C. E. F. asks: Could you tell me the properties that they use in making dry batteries? A. The materials used in dry batteries are sal-ammoniac, zinc oxide, plaster of Paris, sometimes flour or starch and water. Powdered carbon and binoxide of manganese are used on the carbon plate. For full instructions how to proceed in making dry cells, we would refer you to SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1001, 1383, and 1387, price 10 cents each. These give the whole story with drawings, sizes, and descriptions.

(9467) H. S. asks: Will you kindly give in your Notes and Queries brief explanation of the optics of the so-called fixed focus lens used in cameras of the "Kodak" type? A. A "fixed-focus" lens is one so adjusted that all objects in the field are in sufficiently good focus for a landscape picture. It must have a short focus, and can only be used on a comparatively small plate. The shorter the focus the greater the depth of focus, that is, objects will be in focus over a wider range. This is, however, a relative matter. In no lens can objects at all distances be in equally good focus. The rule frequently employed in making fixed-focus cameras, as laid down by a writer on the subject, is: "If the diameter of the stop be a fortieth part of the focus of the lens, the depth of focus will range from infinity to a distance equal to four times as many feet as there are inches in the focal length of the lens." Thus with a four-inch lens, all objects beyond sixteen feet will be in focus. A different result is given in a table published in Taylor's "Optics of Photography," price $1, from the report of a committee of the Amateur Photographic Society of New York.

(9468) G. R. F. asks: 1. Can you oblige me with a good formula for dry cells? A. A very useful formula for dry cells is: Oxide of zinc, 1 part; ammonium chloride, 1 part; plaster of Paris, 3 parts; zinc chloride, 1 part, water, 2 parts. All parts are given by weight. All dry cells owe their action to ammonium chloride. We have published in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1383 and 1387, price 10 cents each, most excellent directions and drawings for making dry cells. You cannot do better than to get these latest instructions and follow them. The directions for compounding the formulas are much more in detail than can be given in a note. 2. Also, have you a later issue of "Wrinkles and Receipts" than 1876? If so, send price, and I will get one. A. There has been no new edition of "Wrinkles and Receipts" since 1876. We recommend you to purchase "The Scientific American Cyclopedia of Receipts," last (1901) edition, containing 15,000 receipts, 734 pages, cloth bound, price $5 by mail or express prepaid.

NEW BOOKS, ETC.

GEFECHTSWERTE VON KRIEGSSCHIFFEN. Von Otto Kretschmer. Sonderabdruck aus der Zeitschrift Schiffbau. V. Jahrgang. No. 18-20. Emil Grottke's Verlag, Berlin SW. 12, Wilhelmstrasse 105. Price, 50 cents.

The readers of the SCIENTIFIC AMERICAN are doubtless familiar with Mr. Kretschmer's formula for calculating the fighting value of ships. In this pamphlet he has given a very thorough explanation of the underlying mathematical principles upon which he places his conception of fighting values. His computations, of course, are based upon those factors which can be determined with certainty, namely, such factors as guns, armament, armor, engine power.

PRACTICAL MEASUREMENTS IN MAGNETISM AND ELECTRICITY. By George A. Hoadley, A.M., C.E. New York, Cincinnati, and Chicago: American Book Company, 1904. 12mo.; pp. 111. Price, 75 cents.

This small volume has been prepared for the purpose of enabling students in scientific courses in preparatory schools to prepare for the more advanced instruction in college. It consists of numerous experiments in electricity and magnetism, which show the various principles and laws governing these forces. The book is very completely illustrated with diagrams and cuts, and treats of such subjects as magnetic induction, galvanometers, batteries of various types, resistances and the measurement of the resistance of batteries, wires, etc. It will be found to very completely answer the purpose for which it was written.

THE TELESCOPE. By Thomas Nolan, M.S., A.M. New York: D. Van Nostrand Company, 1904. 32mo.; pp. 128. Price, 50 cents.

This volume forms the second edition, revised and enlarged, of this practical and useful little handbook. Besides the chapter on the optical principles involved in the construction of refracting and reflecting telescopes, the second edition contains a new chapter on the evolution of the modern telescope to date—an evolution which has made possible the wonderful progress in celestial photography, which has revealed so many new stars and satellites. The book also contains a list of all recent books, scientific papers, and periodical literature relating to telescopes, observatories, celestial photography, spectroscopy and spectroscopes, telescopic accessories, and the making of observations.

THE CENTRIFUGAL PUMP, TURBINES, AND WATER MOTORS: Including the Theory and Practice of Hydraulics. By Charles H. Innes, M.A. Manchester, England: The Technical Publishing Company, Ltd., 1904. New York: D. Van Nostrand Company. 12mo.; pp. 340. Price, $1.75.

The present, or fourth, edition of this valuable work has been enlarged by the addition of a chapter on centrifugal pumps for high lifts, and fans or blowers capable of creating considerable pressures. Following the opening chapters on hydraulics, the measurement of the power of streams, friction of piping, etc., hydraulic engines and both axial and radial flow turbines are discussed theoretically and described practically. The Pelton or tangential water wheel is also dealt with, and there are several chapters on centrifugal pumps. One chapter deals with the great hydraulic plant at Niagara. The book is both theoretical and practical in character, and will be of great advantage to all who have to do with hydraulic machinery.

SPANGENBERG'S STEAM AND ELECTRICAL ENGINEERING. In Questions and Answers. By E. Spangenberg, M.E.; Albert Uhl, A.I.E.E.; and E. W. Pratt, Master Mechanic. St. Louis: George A. Zeller, 1904. 8vo.; pp. 672; 648 engravings. Price $3.50.

This is a carefully-prepared textbook covering the field of steam and electrical engineering by means of more than a thousand questions and answers. The three experts who are responsible for the work have not only the necessary knowledge, but also the rarer gift of ability to impart it, Mr. Spangenberg having been formerly superintendent of the St. Louis School of Engineering, and Mr. Uhl an instructor in the same school. Mr. Pratt has made the locomotive a life study, and his contributions, simple and direct in style, go to the heart of the subject in few words, and are thus in harmony with the spirit of the whole. Among the themes treated are compressed air, mechanical refrigeration, gas and gasoline engines, and hydraulic elevators. The diagrams and illustrations are not reproductions from photographs of old cuts, but were all drawn by hand for the particular purpose in view. Evidently neither time nor expense has been spared to make the manual a success as a teacher and guide, and the result seems to have fully justified the expenditure.

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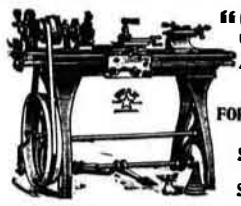

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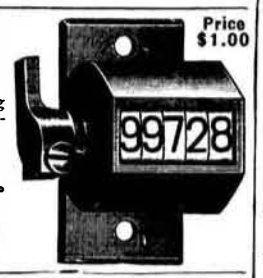

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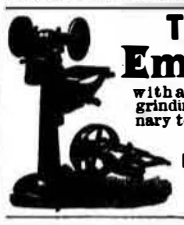

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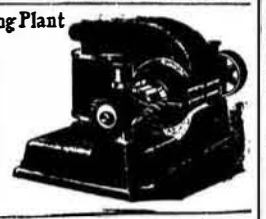

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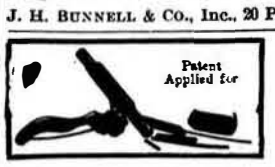

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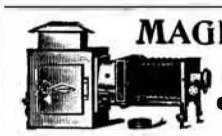

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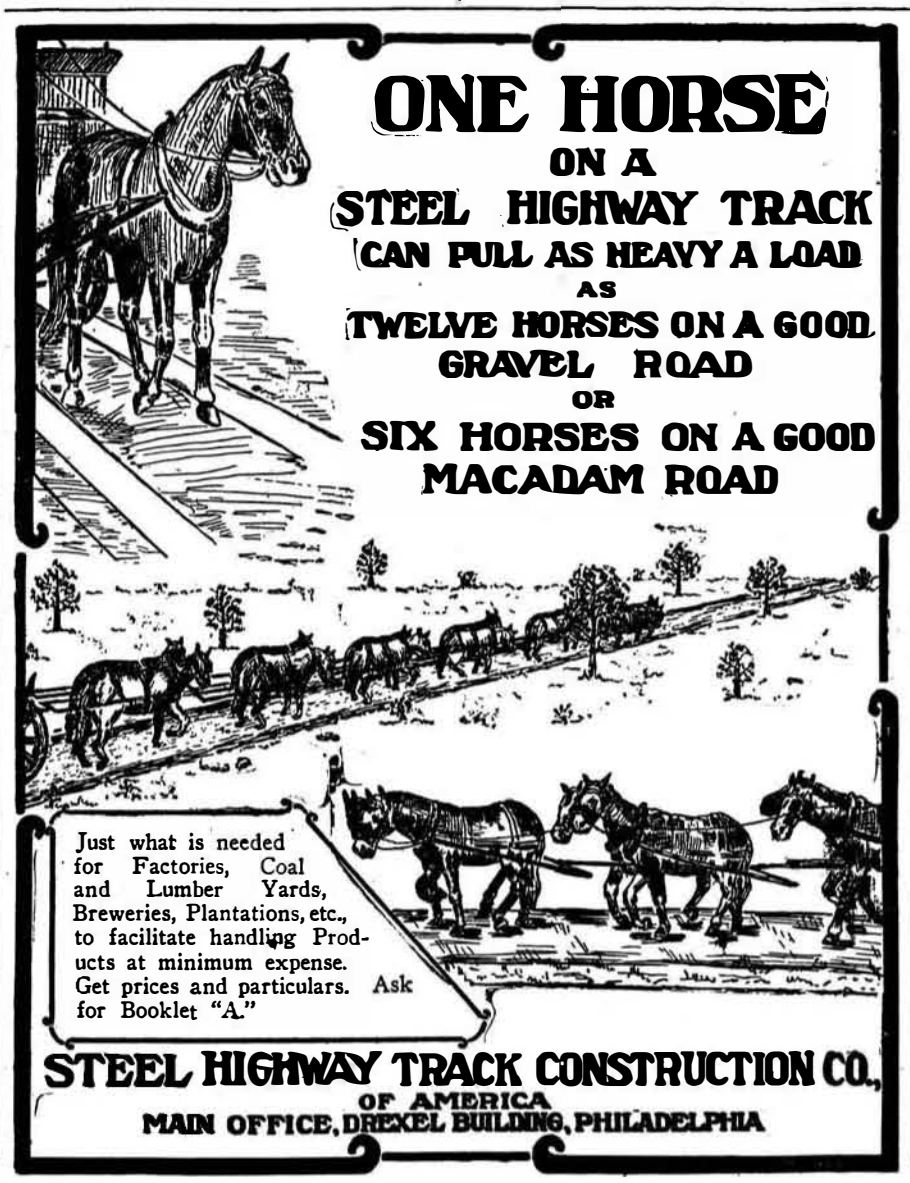

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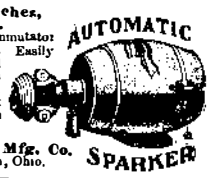

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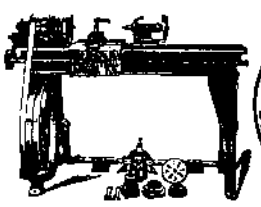

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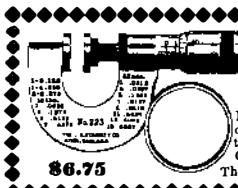

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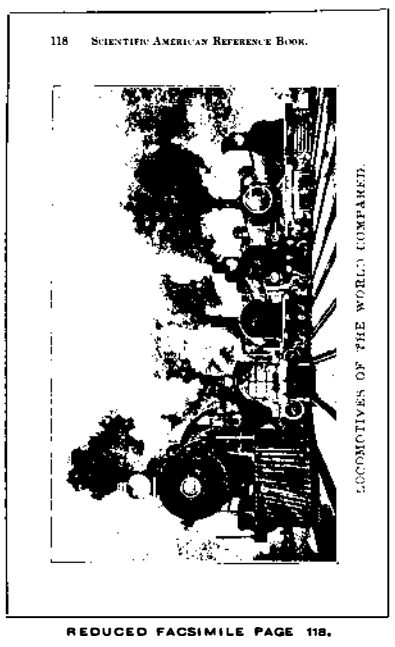

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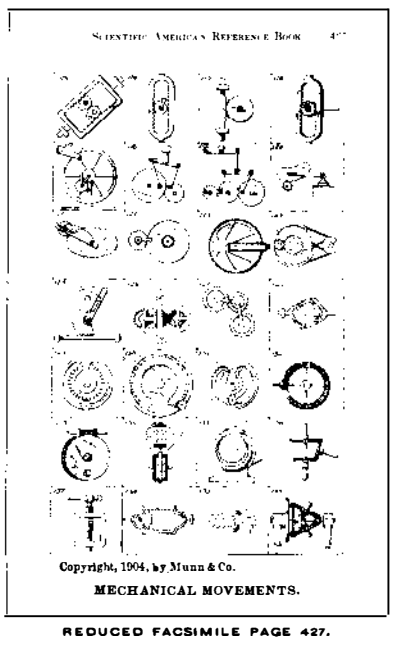

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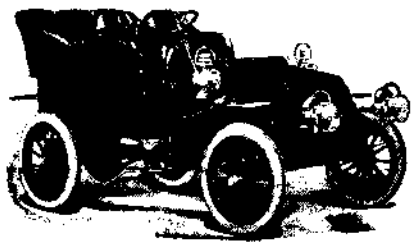

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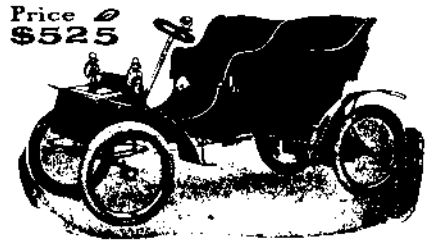

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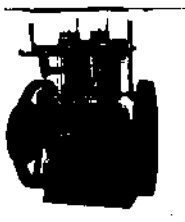

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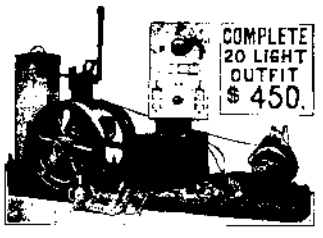

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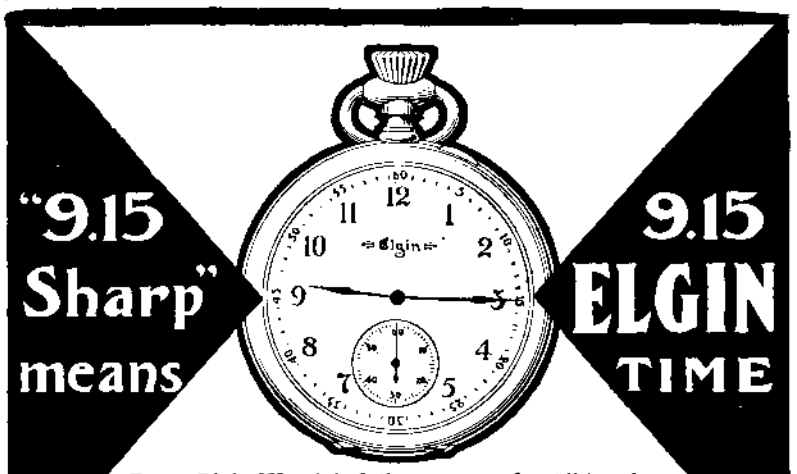

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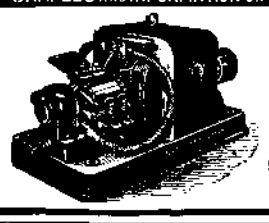

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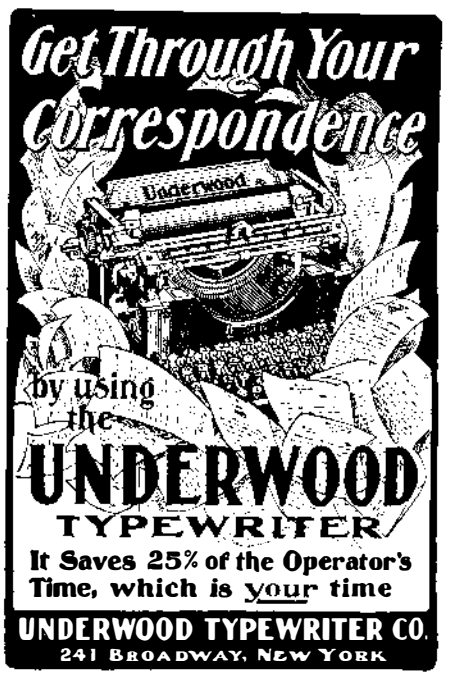

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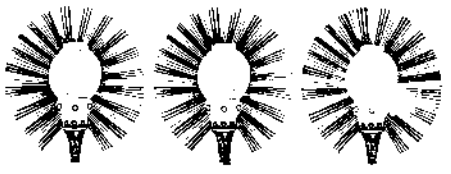

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